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ELECTRO-METALLURGY.

A good deal has been written on the subject of electro-metallurgy, but, at the same time, little practical work has resulted from it. From time to time we have a few patents taken out which relate more or less directly to electro-chemical processes and to means of reducing metallic ores, and spasmodic attempts have been made to work such processes but the support which the schemes have received from the public has been very trifling, and, practically, failure has been the result. For a brief interval the brilliant and interesting experiments of the late Sir William Siemens on the smelting of metals by electricity promised to lead to some definite move being made, but up to the present time no further progress seems to have resulted in the matter. The most favourable field for operations seems to be in the direction of extracting metals from their ores, but, although several patents have been taken out for processes which are stated to effect the object in view, yet these processes have but rarely been worked. Considering the extremely depressed state of the metal market any method of avoiding the use of coal fuel for smelting purposes, and substituting electrical power generated by the forces of nature in its place, would seem to have a prospect of success, provided, of course, the new process were a cheap one. The fact that electro-extraction has not been practically applied would seem to indicate that no margin of economy can be shown to exist, even if the process could effect what it claims to do. In electro-plating there appears but little scope for improvement, though methods of successfully depositing certain of the metals, and especially platinum, have yet to be discovered.

AN ELECTRICAL TESTING ESTABLISHMENT.

OUR contemporary, the *Engineer*, in an article under the above heading, has put forth a suggestion with which we heartily agree; it is that an establishment should be formed in which all kinds of electrical testing work can be carried out by inventors. At the present day there are numbers of men whose ideas, although good, remain dormant, or are turned in the wrong direction, simply from their inability to practically test them on account of want of facilities for doing so. A new electric lamp is devised, for example, by an amateur, but to practically test it a powerful and steady electric current is required; as this is not available he tries the experiment with a few battery cells, and if he gets anything like a result he continues his experiments on the same lines, and when he has satisfied himself that all is right, he perhaps gets an introduction to an electric light establishment, and he now tries practically what he has only tried on a small scale, the result often, and in most cases, being that he finds he has gone on completely the wrong track, and that much of his labour is thrown away. In telegraphy, and especially submarine telegraphy, amateurs are especially liable to work astray, as they design their apparatus to work through an ordinary resistance, and then imagine that they have achieved a success, quite overlooking the fact that resistance is but one element that affects the working of telegraphic apparatus. Inductive retardation, which has quenched the ardour of more than one inventor is not thought of, or rather is made light of. In a case like this, were an artificial cable available, the inventor could by a test at once see whether he was on the right road or not, and would be saved much trouble and disappointment. In an establishment of the kind it would be very necessary that the inventor should be able to carry on his experiments in the utmost privacy and without fear of disturbance; thus, as our contemporary points out, if he wishes to test an electric lamp "he would be assigned a dark room and two terminals, giving him whatever current and potential he might require. If he found that small changes were necessary a workshop would be available, and he would be saved the loss of time which might be incurred in removing his lamp and bringing it back again." No doubt work and experiments carried on in this way might at first to some extent diminish the demands for opinions and advice from professional experts, and, therefore, the latter might be opposed to the foundation of an establishment of the kind; but eventually the stimulus which the facilities must give to many workers will increase the demand for professional opinions, as without the latter no enterprise would be taken up by the public.

ELECTRIC CONDUCTIVITY AND THERMIC CONDUCTIVITY.

WHEN concluding the interesting communication which he made in the month of May to the International Society of Electricians, M. Lazare Weiller announced that he is about to undertake a new series of researches on the relations existing between the electric and the thermic conductivities of metals. According to him the figures published by MM. Wiedemann and Franz, which seem to show that, as regards the two properties of which we are speaking, the metals may be arranged in the same order, cannot be accepted without reserve. In his opinion, in fact, the electric conductivities have required important corrections which have changed their order of classification. To quote merely a single case, he places copper along with silver at the head of his table, whilst Wiedemann and Franz give it only the second place with the coefficient 73. He has, further, raised other serious divergencies, and guided by an idea which we shall discuss below, writes M. Clemenceau in *La Lumière Electrique*, he has resolved to undertake a new study of the question.

The apparatus which M. Lazare Weiller employs is that known as the apparatus for "thermic conductivities," of which M. Zannetaz, superintendent of

lectures at the Sorbonne, is the inventor. It consists essentially of a platform on which is placed the fragment of metal, the conductivity of which is to be measured, and which has been previously covered with a thin coating of wax. At the point of contact there is a small sphere of platinum, of the size of a pin's head, placed at the summit of the angle formed by a platinum wire bent upon itself. This wire, which is supported by a movable chariot so as to make or destroy the contact, passes through a copper box pierced in its centre with a cylindrical aperture, and which is traversed by a current of cold water. When we pass the current of a battery into the wire the small sphere becomes heated, melts the wax and forms a zone, circular or elliptical, the dimensions of which, having regard to the temperature of the platinum wire and the duration of the contact, permit us to measure the conductivity of bodies.

We have no comments to make on this manner of experimenting, nor on the interest presented by researches of this order. The question evidently deserves to be completely re-examined, and we are convinced that M. Weiller, whose competence in these matters cannot be questioned, renders a service to science by endeavouring to furnish a series of trustworthy values which may be of great utility. But though we shall hasten to make public these results when they appear, we have already to make certain reservations as regards the idea which inspires them. According to M. Lazare Weiller the general tendency of physicists to admit an intimate connection between heat, light, and electricity is not absolutely well-founded. The discrepancies which he has found in comparing the phenomena of electric and thermic conductivity seem to him an argument calculated to throw doubt upon this supposed analogy. Certain facts which he has detected in the electric resistance of alloys seem to him a strange anomaly, the explanation of which puzzles him and which he seeks in a direction where we are unable to follow him.

The essence of electricity will never be known to us, any more than that of heat, or light, or even of thought, whatever researches we may accumulate in this direction. It is only possible for us to ascertain phenomena to discover the laws by which they are governed, and to draw from them practical conclusions which we may submit to experiment; but to aim at ascending to their ultimate cause is to return to the philosophical studies of past ages and to conclude merely with hypotheses, more or less probable, which nothing can verify. Electricity, heat, light, sound have no existence. They are mere abstractions, words without real meaning and which only designate a special state of matter. We are in presence of phenomena which produce different effects upon our senses. We are compelled to class them under various heads, and to study them separately in their special manifestations. But nothing compels us to admit for each of them a special cause, a *fluid* as it is said, having a distinct existence. Without even wishing to penetrate to the bottom we see all the physical phenomena before our eyes, connected together in such a manner that we can mark out their boundaries. None of them manifests itself alone, and all the divergencies which we may discover prove nothing, since if the analogy were complete these agencies could not be distinguished. Scientific method ought, therefore, to preserve its character if we wish to arrive at a result. To view the phenomena under all their forms in order to seize their laws and find their utilisation, is a task so immense that we are not tempted to pass the boundaries of the real world and let our minds wander in quest of the absolute. It is true that we may often be involuntarily carried away in one direction or other, according to the conceptions which we may please ourselves with forming; it is therefore needful to keep a close watch upon ourselves. In the present case we reproach M. Weiller for having travelled somewhat beyond his subject, and for having, we do not doubt, allowed his words to outrun his thoughts.

"This is an opportunity," says he, "to recall the theories advanced by several eminent physicists, and, among others, by Clerk Maxwell. But these theories are still so hypothetical, and their interpretation appears to me so abstract, that I fear to adventure upon this ground."

"Nevertheless it is not rash to affirm that in the resistance opposed to the passage of an electric current the magnetic orientation of the molecules of each body plays a certain part. Each of them, finding itself influenced by the passage of the current may, in various degrees, according to its composition, *modify the resistance* of the conductor."

It is difficult to understand how, after having written the first of these sentences, in which M. L. Weiller declares himself unwilling to venture into the realms of abstraction, he has been able to add the two succeeding ones which plunge us without any transition fully into the hypothetical. To begin with, does the magnetic orientation of the molecules of a body play any part, and if so what part? We know here absolutely nothing. Strictly speaking, and without compromising ourselves in any manner, we may admit that under the influence of a current the molecules of a body may arrange themselves in different manners and contribute thus to what is called the resistance of the conductor. This is a conception of the mind; but to go further and say that this same orientation modifies the resistance is an assertion which has no longer a meaning. We cannot measure an electric resistance without causing the conductor upon which we are experimenting to be traversed by a current. We know, indeed, that this resistance may vary with the intensity of the circulating current, but this has no connection with M. Weiller's assertion. If we keep to the sense of his words he believes that there exists in a conductor of electricity a proper specific resistance, and that this resistance is modified by the passage of a current. With such a hypothesis we no longer know where to stop, and we can only reason vaguely on the existence of phenomena whose existence cannot be proved, and which, further, present no interest. We do not know absolutely how an electric current traverses a conductor, being ignorant both how the atoms of the conductor are arranged side by side, and what momentary modifications in their arrangement the passage of a current may involve. According to M. Weiller we may ask if, in certain cases, as for instance in that of alloys, the compound molecules may not behave like so many elementary electric couples having a specific electromotive force which determines the passage of a current and which produces in the entire mass a series of particular currents analogous to the so-called currents of Foucault, the effect of which is to contravene the passage of the general current. For our part we do not see upon what this supposition can be built. The currents of Foucault, developed in pieces of bronze, moving in a magnetic field having nothing in common with those which may take their rise in the interior of a conductor in presence of a current. Nothing can lead us to this hypothesis, especially the example cited by M. Weiller. Considering an alloy of 50 per cent. gold and 50 of silver, composed of two wires of 1 millimetre in diameter, the one (that of silver) having a resistance of 19 ohms per kilometre, and the other (that of gold) 24·36 ohms, he finds, on applying the law of derived circuits a total resistance of 10·67 ohms, whilst after having melted the two wires together into one of the same length, but of a double section, the resistance of the alloy rises to 58·50 ohms. This result shows, says he, that the application of the rule of derived circuits does not suffice to explain the singular phenomena presented by the electric conductivity of alloys.

For us there is here nothing surprising, as we have never supposed that the rule of derived circuits could give a notion of the resistance of an alloy. We are absolutely ignorant how the molecules of two alloyed metals are arranged; we do not even know if there is a law which governs their arrangement, but, in any case, whatever suppositions we may frame it is not permitted us to apply here the law of derivations. In fact, if we consider merely the two wires in question, not melted, but

placed side by side in contact, we can no longer make use of the formula of derived circuits because the points of contact are unknown to us. On their leaving the crucible therefore, *a fortiori*, the law in question is no longer applicable. Under such conditions we must hold to the point which alone presents a practical interest: to have conductors for electricity, which, for a given current, absorb the least heat—this is all. For this reason electricians have favourably received silicium bronze, the good properties of which we have had occasion to verify. More than others M. Weiller knows that the practical side of these matters is the only one which concerns us, without having to disquiet ourselves concerning the reciprocal action of the molecules upon each other in a light, tenacious conductor of little resistance. Beyond these practical sides we refuse even to recognise the scientific interest which there may be in searching in facts for the proof of a hypothesis which rests entirely upon the existence of an abstraction.

The services which M. Lazare Weiller has rendered to electric industry by his studies on the bronzes are beyond discussion, and it is on this account alone that we have permitted ourselves to criticise, from a philosophic point of view, the ideas and theories contained in the conclusion of his last memoir.

THE ORGANISATION OF THE POST AND TELEGRAPH SERVICE IN FRANCE.

(*Continued from page* 29.)

THE French Administration possessed, since 1864, at Toulon, a small factory for re-covering cables, as well as two ships, the *Ampère* and the *Charente*, fitted out for laying cables.

These works, erected on grounds belonging to the Military Engineers, had been established with the idea of repairing, or partly renewing, short lengths of cables which had already been in use, and to look after the maintenance of our coast cables.

This work was done, in that factory, under conditions of remarkable economy. The cost prices were there considerably lower than those which had to be paid to private contractors. This, of course, did away with the general expenses and the normal profits which a contractor always expects to realise, and finally a reduction in the working expenses, as the crew of the *Charente*, during the intervals that the ship was lying up, were employed in stripping picked up cables of their sheathing wires which were of no further use, and in joining up the pieces of core. Lengths of core thus repaired and recovered with jute and new iron wires have been used again for connecting the islands in the Mediterranean and in the ocean with the mainland. This resulted in an annual saving of a sum of more than 50,000 francs.

But the work of this factory, with the means at its disposal, was limited to the maintainance of cables in shallow water only. In 1879 the enlargement of these works became necessary, as the existing machinery had become insufficient for the present wants.

In order to repair our cables, or to reply to the requests which have several times been forwarded to us by other countries to repair their cables, we constantly require to have at our disposal the special machinery and stores of a factory, and of the ship the *Charente*.

A credit of 300,000 francs was voted for the building of the new works, and by a decree, dated the 10th January, 1881, a piece of ground, having an area of 10,654 square metres, situated in the parish of "la Seyne-sur-Mer" (near Toulon), was appropriated for the Post and Telegraph service.

The installation there of a new and important establishment is finished. Provided with powerful machines, fit to make the two types of cables usually employed, these works can supply up to 9 kilometres of cable per day, thus answering to any present or future requirements.

Henceforth we are able, without having recourse to foreign firms:—

1. To guarantee the requests of the naval department for cables required for batteries and coast defence.

2. To supply the material necessary for the maintainance of our submarine system, which extends itself every day in the Mediterranean and along our islands in the ocean, and also for our system of underground wires.

3. To satisfy the wants of the Powers, our neighbours in the Mediterranean, who, as we have stated before, applied freely to our engineers to repair their submarine cables.

Besides, independent from its usefulness as regards the maintainance of our submarine communications, this establishment will be a very valuable school of practical instruction; officials of all grades can take part there in operations of a special nature, which they otherwise would seldom have the chance of studying.

The efforts already made, and the results obtained, have shown us that the Administration, with a sufficient outfit, could lay themselves cables of a certain length, especially cables between France and Algiers, and would thus often escape the exigencies of foreign contractors.

Private Wires.—The necessity of giving, in the general interest, the largest possible scope to telegraphic communication being evident, we have striven to offer to the public all possible facilities to obtain the concessions for private telegraph lines.

Until 1878 the concessions for such lines had not been subjected to fixed rules. A project to regulate them was being considered since 1864, but it never had been definitely settled. The conditions agreed upon with the concessionnaires varied according to circumstances. The Administration had completely ignored all those concessions which had been granted by prefects or mayors of towns without first consulting them in the matter.

As regards the concessions, the granting of which was reserved to the Administration, it supported the cost of establishing the lines by imposing on the concessionnaires a tax, intended to cover the cost of maintainance, and to gradually pay off the outlay for the material; this tax or rent itself had no fixed basis.

From the year 1872 it was generally at the rate of 30 francs per kilometre of wire. During the year 1874 this appeared to be insufficient, and it was increased to 50 francs per kilometre of wire; it remained fixed at that rent until the end of 1877.

In reality, private telegraph lines were not granted until after repeated demands, and even then only with reluctance. A solution of this question, which at the same time would protect the monopoly of the State and satisfy the interests of the public, had not been sought after; the development of this branch of telegraphy was restricted by every means. In spite of the advantages which they offered by decreasing the distances between the different parts of any one establishment, or with the nearest telegraph office, those lines were but little developed.

The new conditions have been fixed by the decree of the 13th May, 1879, and by the resolution of the 20th of that same month. They have given a fresh impulse to the development of that system, and granted facilities which, by multiplying the concessions, have increased the profits which the State is bound to make by them.

Trade, at the same time, has greatly profited by them.

These regulations divided the private lines into two classes: the first one consisting of all those which connect private houses with the system of the State, and the second one of those lines which enable two or more private houses to communicate with each other direct.

The concessionnaires share in the cost of erecting and maintaining the lines. The hire of these lines, calculated on the basis of an annual rent, has to be paid only for those lines which connect private establishments with each other.

The number of the concessions, at the time that this new regulation came into force, amounted to 199, about one-half of which had been granted by the Prefects, and were scarcely known to the Administration.

Complete details of all those concessions have had to be obtained, and often with great difficulty. As to the greater part of those lines, it was not even known whether they were still working. Drawings showing the routes and statements as to the development of the wires had to be gathered together to enable us to fix the amounts of the rents which the concessionnaires had to pay.

187 former concessionnaires have assented to the new conditions, whilst 12 only have given up their lines.

These 187 concessions previously paid to the Treasury a total rent of 66,000 francs. As, however, some of the separately conceded systems amalgamated to form one single one, 167 new contracts were drawn up, representing 1,944 kilometres of wire, and producing annually: rent of wire, 69,000 francs; maintenance, 28,000 francs, or a total of 97,000 francs.

The new system, therefore, yielded to the Treasury an increase of 31,000 francs, or say more than 45 per cent.

That it was received by the public with no less satisfaction is proved by the result, because it substituted fixed rules for optional ones, and made every one pay the same rents.

The obtained results enabled us, without any loss to the Treasury, to introduce certain reductions, and by two successive resolutions, dated the 24th February, 1882, and the 31st December, 1882, we reduced from 50 to 25 francs per kilometre the rent which had to be paid for private lines, besides which the first two stations mentioned in each concession were exempted from any fixed rate.

The new tariff applied to the lines that were in existence on the 31st December, 1882, shows a reduction of 70,000 francs, or 25 per cent., as compared with the amount produced by the previous rates.

The following table shows the state of the private lines on the 1st January, 1884, as well as the consequences of the successive reductions of rents.

It needs no further comment to point out the enormous development that has taken place in private lines since the alterations of 1879, when we notice that in the year 1882 alone, 350 new contracts were granted, *i.e.*, double the amount of those granted from 1857 until 1878, and that in 1883, even that number has again been doubled, as the number of concessions for such lines amounted to 704.

From the end of 1878, until the 1st January, 1884, the length of wires has increased from 1,994 to 6,513 kilometres, whilst the receipts for the Treasury, from being 97,000 francs, became

245,000 francs, notwithstanding the successive reductions in the tariff.

These figures are steadily improving.

Date of Grant of Concession.	Number of Contracts.	Total Addition of Wires.	Treasury Receipts.		
			Rent as per Resolution of 31st December, 1882.	Maintainance.	Total.
Concessions Granted.		Kilos.	Francs.	Francs.	Francs.
From 1857 to 1878 ...	167	1,944	38,450	28,000	66,450
In 1879	43	287	4,050	8,000	12,050
„ 1880	134	835	12,900	15,000	27,900
„ 1881	253	1,215	16,646	32,000	48,646
„ 1882	350	1,250	18,975	34,295	53,270
„ 1883	704	982	24,289	13,041	37,330
Total of the Concessions on the 1st January, 1884	1,651	6,513	115,210	130,336	245,546

To complete the preceding table, we should further state that the number of private stations, which at the time of the new regulations—

in the former contracts amounted to	... ...		495
have increased during	1879 by	... ...	55
„ „ „	1880 „	... ...	245
„ „ „	1881 „	... ...	569
„ „ „	1882 „	... ...	656
„ „ „	1883 „	... ...	1,025
and at present amount to		... ...	3,009

Of this number, 440 may be considered as being real branches of the Government offices, with which they are connected. The others, to the number of 2,659, work outside the general system; but should the wants of the Administration require it, they can at any moment be made use of. They form thus a kind of auxiliary network to the State system.

We have further increased the facilities granted to the concessionnaires of private lines, connected with the general system, by authorising that on the payment of a fixed rate, direct communication may be established between two of such lines, should they both be connected with one and the same office. We have also allowed the transmission, per Government office, of messages intended to be sent on by post, on payment of a rate of 50 centimes for 100 words, besides the postal rate, or sending them by telegraph.

We ought further to remark that the rules observed for private lines in France are less onerous and more favourable to the public than in any other country.

Telegraphic communications thus extend, in quick progression, to the remotest parts of the country; they are no longer limited to important towns; they go to the small villages, farms, and solitary country houses. In the towns they connect large trading firms, the factory with the warehouse, the private dwelling with the office.

The number of private lines extending outside towns or localities provided with telegraph offices, amounts to 685; the number of lines which work inside the radius of towns to satisfy the wants of trade and commerce and private relations, amounts to 937; whilst to these should be added 29 for the service of the Press. This gives thus a total of 1,661.

Eight newspapers, or newspaper agencies, are in direct communication with the Senate, and ten with the Chamber of Deputies.

Speaking of private wires, we ought to mention that there exist also a certain number of municipal systems, which, as such, are exempt from paying rent.

The municipal system of the City of Paris, is very important indeed; it has not been included in the results already stated. Its total length to-day exceeds 975 kilometres of wire, for the maintenance of which the State receives from the City the sum of 76,500 francs, as shown in the following table.

USE OF THE SYSTEM.	Total length of the wires. Kilometres.	Number of stations.	Maintenance paid to the State. Francs.
Public service	106	94	8,003
Water service	240	115	12,100
Municipal buildings ...	113	75	8,430
Prisons	24	16	1,860
Police	145	105	9,954
Fire brigade	346	505	33,093
Time signalling	51	...	3,060
Totals	1,025	910	76,500

The telegraph system of the fire brigade connects all their stations in Paris, and in case of fire it enables a call to be made immediately to all the stations, should the case prove serious. Private houses can be connected with the system of the fire brigade by means of lines, constructed and maintained at the expense of the proprietors, or tenants, by paying to the Administration a single annual rent of 25 francs.

Thirty-eight houses have already taken advantage of this facility.

We have even adopted a system which allows several intended parties to be served by one and the same wire, which, of course, reduces the costs of the first outlay.

Newspapers were already allowed to hire wires, during certain hours, but this had become insufficient to the wants of the Press.

By the law of the 5th April, 1878, the Administration was authorised to accept reduced rates for the transmission of messages, when this transmission could be effected without interfering with the ordinary conditions, fixed for the application of the telegraph rates. The Administration has therefore started on a new track by allowing, especially to newspapers, to share, at the rate of 100 francs per kilometre for overhead wires and of 700 francs per kilometre for underground wires, in the cost of erecting special wires for long distances. At fixed hours those wires are placed at the disposal of the concessionnaires, but by the intervention of the Government offices, who transmit at a rent reduced to 24 or 12 francs, according to the hours, Press messages, forwarded between 4 o'clock in the evening and 10 o'clock in the morning; or at the full rent during the other hours, or those messages which are not intended for publicity. Under these conditions a wire from Paris to Marseilles contributes 100,000 francs; a wire from Paris to Bordeaux 72,000 francs. The amount of the receipts obtained from the rent of 15 Press wires, may be estimated at 220,000 francs per annum.

Two wires have thus been established between Paris and each of the towns of Marseilles, Lyons and Bordeaux; one wire between Paris and Montpellier, Roubaix, Charleville, Tours, Dijon and Toulouse. Besides which, a wire has been given to Nice, *viâ* Lyons, and Marseilles; another one to Toulouse, *viâ* Bordeaux, and finally, one to Roubaix, *viâ* Lille, or a total length of 8,800 kilometres, and towards which the concessionnaires have contributed a sum of 1,150,000 francs, as part of the cost of first outlay.

The State has the use of those wires during certain hours of the day, more especially as regards the Press wires, from 10 o'clock in the morning until 4 or 5 o'clock in the evening, *i.e.*, during that part of the day when the ordinary traffic of the general system is greatest.

The development of this special system therefore forms a very valuable practical resource for the Administration, whilst it contributes at the same time to the increase of its revenue.

The ordinary system of hiring a line is the only one which it has been possible, up till now, to apply to international relations.

Our aim in all these questions, both as regards the private lines and the hiring of the wires placed at the disposal of the press, has always been to adopt fixed rules, entirely avoiding optional ones; we have desired to have tariffs uniformly applicable to everyone, and of which all might profit without distinction.

(To be continued.)

THE ELECTRIC LIGHT IN RELATION TO HEALTH.*

By R. E. B. CROMPTON.

In early times but a small fraction of our forefathers' lives was spent under artificial light; for as a rule, after sunset they lived in semi-darkness. But as man has advanced in civilisation there has been a steady increase in that fraction of our lives which is spent under light other than that of the sun. But the improvement in the quality of the artificial light has been very slow. A few years before the introduction of gas, Argand, by his improvements in the burners of oil lamps, enabled our fathers to see for the first time a comparatively white light; but as far as the matter we to-day propose to discuss is concerned, viz., the effect of artificial lighting, and more particularly electric lighting, on our health, we need only consider the reign of artificial light, as it commenced with the general use of gas and petroleum, for then, and only then, could it be said to affect our health. Prior to the introduction of the electric light we have been accustomed to consider every hour spent under artificial light as an hour during which all conditions are less favourable to perfect health than during daylight. Can we now hope to ameliorate this condition of things through the agency of electricity? Before we can discuss this question I must point out to you the chief differences which exist between hours of work or recreation spent in daylight, and under artificial light. In the former case we live in abundance of light. The sun light itself exercises a subtle influence on our bodies; that mixture of heating and chemical rays which, when analysed, form the solar spectrum, and com-

* A paper read before the Society of Telegraph Engineers and Electricians at a conference held at the International Health Exhibition, on Friday, July 4th, 1884, Prof. W. Grylls Adams, President, in the Chair.

bined, form the pure white light of daylight, is needed to enable all animal and vegetable organisms to flourish in the fullest conditions of healthful life. In nearly all cases when the sun is up, the functions of life are in the state of fullest activity, and when it sets they sink into comparative repose. In daylight, life wakes; in darkness, life sleeps. In addition to the abundance of pure white light, the heat attending is only that necessary for health. The air remains unvitiated except by our own breathing. On the other hand, when working under artificial light, we have these conditions all altered in degree; first we have an insufficient light; a scale of lighting by gas or by electricity which would be pronounced excessive at night time, is still far inferior to average daylight.

2nd. All artificial lights, whether produced by combustion, as in the case of candles, oil, gas and petroleum, or by the incandescence of a conductor by the means of electricity, produce heat, which in proportion with the light afforded, is enormously in excess of the heat given by sun light. Electricity, as you will see hereafter, is far the best in this respect, but even it is inferior to sun light.

3rd. All illuminants, excepting electricity, contaminate the air and load it with carbonic acid, carbonic oxide, sulphur and other compounds, all injurious to the health and to the general comfort of the body. It will be convenient to consider the effects, 1st, on our health generally; 2nd, on our eyesight in particular. The various artificial lights differ very widely from sun light in this respect, that they are all more or less deficient in the rays at the violet end of the spectrum, commonly called the actinic rays, and which most probably exercise a very powerful effect on the system. It is the want of a due proportion of these violet rays which makes all artificial light so yellow. Even the light of the electric arc, which is richer in these rays than any other, is still on the yellow side of sun light. The incandescent electric light is next best in this respect; next in order come gas, petroleum and the various oil lamps.

Turning now to the comparative heating and air vibrating properties of artificial lights, I have here a table prepared by Dr. Meymott Tidy which shows the oxygen consumed, the carbonic acid produced, the air vitiated and the heat produced by the combustion of certain bodies burned so as to give the light of 12 standard candles; to which Mr. R. Hammond has added the heat produced by a 12-candle incandescent electric lamp.

TABLE A

Showing the oxygen consumed, the carbonic acid produced, and the air vitiated, by the combustion of certain bodies burnt so as to give the light of 12 standard sperm candles, each candle burning at the rate of 120 grains per hour:—

Burnt to give light of 12 candles, equal to 120 grains per hour.	Cubic feet of oxygen consumed.	Cubic feet of air consumed.	Cubic feet of carbonic acid produced.	Cubic feet of air vitiated.	Heat produced in lbs. of water raised 10° F.
Cannel Gas	3·30	16·50	2·01	217·50	195·0
Common Gas ...	5·45	17·25	3·21	348·25	278·6
Sperm Oil.....	4·75	23·75	3·33	356·75	233·5
Benzole.....	4·46	22·30	3·54	376·30	232·6
Paraffin	6·81	34·05	4·50	484·05	361·9
Camphine.....	6·65	33·25	4·77	510·25	325·1
Sperm Candles...	7·57	37·85	5·77	614·85	351·7
Wax	8·41	42·05	5·90	632·25	383·1
Stearic	8·82	44·10	6·25	669·10	374·7
Tallow	12·00	60·00	8·73	933·00	505·4
Electric Light...	none	none	none	none	13·8

From these figures you will see that the air of a room lighted by gas is heated 20 times as much as if it were lighted to an equal extent by incandescent electric lamps. When arc lamps are used the comparison is still more in favour of electricity. You would be surprised to see from the table that our old friend the tallow candle, and even the wax candle, is far worse than gas in the proportion of air vitiated and heat produced, and you will be disposed to disbelieve it, but the fact is that so long as candles were used light was so expensive that we were obliged to be content with little of it; in fact we lived in a state of semi-darkness, and in this way we evaded the trouble. It is only since the general introduction of gas and petroleum that we have found what an evil it is.

It is not unusual, in fact it is almost invariable, for us to find the upper stratum of air of the rooms in which we live heated to 120 degrees after the gas has been lighted for a few hours. We have grown accustomed to this state of things, and are not surprised that when we take the library ladder to get a book from the upper shelf we find our head and shoulders plunged in a temperature like that of a furnace, producing giddiness and general *malaise*. Looking again at the table it will be seen that each gas burner that we use consumes more oxygen, and gives off more carbonic acid, and otherwise unfits more air for breathing than one human being, and it is this excessive heating and air vitiation combined, which are the main causes of the injury to the health from working long hours in an artificial light.

During the grand Birmingham Musical Festival which was held in the Birmingham Town Hall two years ago, some careful experiments were made to show how the orchestra and audience in the hall were affected by the two kinds of lighting. The gas lighting was in the form of several huge pendants suspended down the centre of the hall. The electric lighting was in the form of clusters of lights placed on large brackets projecting from the side walls with two central pendants placed between the gas pendants. The candle-power given by the electric light was about 50 per cent. in excess of that given by the gas light; the degree of illumination by electricity was consequently very brilliant. It was found that when the gas was used the temperature near the ceiling rose from 60 degrees to 100 degrees after three hours lighting. The heating effect of the gas was therefore the same as if 4,230 persons had been added to the full audience and orchestra of 3,100. Similarly, the vitiation of the air by carbonic acid was equal to that given off by the breathing of 3,600 additional persons added to the above audience of 3,100. But on evenings when the electric light was used, the temperature only rose 1½ degrees during a seven hours' trial, and the air, of course, was only vitiated by the breathing of the audience. The further experiment was tried of giving to every member composing the large orchestra a printed paper of questions asking him how the new mode of lighting affected him or her personally, and I have here 265 replies to those questions. From these it appears that, without exception, the comfort and general well-being of this large orchestra were increased enormously by the use of the new illuminant; it is reasonable to suppose that that of the audience was increased in an equal degree. Now, we all of us know that the times when we suffer most from the effect of artificial light is in crowded places of public amusement which are at the same time brilliantly lighted. Many of us are unable to go to the theatre or to attend evening performances of any kind, as the intense headache which invariably attends through staying a single hour in such places, entirely prevents us. This headache we commonly say is due to the heat and glare of the gas. Now this phrase is not strictly correct. It is no doubt due to the heat of the gas and its air vitiating properties; but when we use the word glare, I believe we refer to the effect the gas light has upon our heads and which effect is not due to excess of light. On the contrary, I believe if a far greater amount of light be given by the electric light without the heating and air vitiation being present, such headache is never produced, although some of the more tender-headed amongst us will at first complain of the glare because they are habituated to associate with plenty of light, great heat, great air vitiation, and other evils.

Indeed, so long have we been accustomed to closely associate brilliant artificial light with headache and glare, that we who are introducing electric light are most cautious not to give the full quantity of light which we could give, and which would afford the greatest rest to the eye and greatest bodily comfort. I come now to the effect that light has upon the temperament. If we try the experiment, in an assemblage of people, of gently decreasing the lighting of the room it will be found that the spirits of every one will be depressed just as the light is depressed, and *vice versâ*, their spirits will be raised just as the light is raised. I have many times when conducting experiments in electric lighting on a large scale, noticed this fact, and I have been led to the conclusion that during hours of waking every person is benefited by increase of light up to the extent of full sun light, providing that this high degree of lighting is not attended by heat and by air vitiation; and I must add that the source of light must not be from one or two brilliant points only, but must be regular, and not such as to cause dark, deep shadows.

This leads me on to the subject of the effects on the eyesight of the electric light as compared with other lights. Healthy eyesight demands a plentiful supply of light. It is the greatest mistake to suppose that a state of semi-darkness is good for our eyes, unless they are defective or recovering from the effects of past injury or disease. Whoever saw a painter, engraver, printer or watch maker, or, indeed, anyone, the quality of whose work depended on the excellence of his eyesight, who did not desire a flood of pure white light thrown on to his work. I think I have the authority of oculists when I say that $\frac{19}{20}$ths of the diseases of the eyes arise from working long hours with insufficient light. Again, another great cause of injury to eyesight is the unsteadiness of most artificial lights. Much improvement has been made in the light of gas during the last few years by the introduction of Argand burners and globes for the flat ring gas burners, having much larger lower openings, so that the dancing and flickering batswing burner of five years ago is not so common in a good house. Even the steadiest of the modern gas burners, however, is extremely unsteady as compared with the light of the incandescent electric lamp.

Hitherto I have said nothing as to the comparative conditions of the two forms of electric light, viz., the electric arc and the incandescent lamp. Both have their proper places. The arc light, which is whitest in colour and most economical to produce, is not so steady as the incandescent lamp. It is therefore unsuitable for indoor use, for reading by, or for such occupations as require the maximum of steadiness; but it is well suited for the lighting of large buildings and public places. The large sorting rooms at the G.P.O. at Glasgow have been for a long time lighted by the arc light, and with a most beneficial result to the health and eyesight of the letter sorters and telegraph clerks. The former occupation is one which tries the eyesight very severely. I am able to boast that by the introduction of the electric light I enabled many of the more aged sorters who were commencing to use spectacles to do without them, and, even, I put back the clock of time in enabling several who had used them for some years to relinquish their use. I am aware that it has been alleged by the opponents of the electric light, whether interested or otherwise, that in many cases the intensity of the light has injured eyesight.

I do not think any such cases can be substantiated. Many of us who are in the habit of experimenting with powerful arc lamps have had our eyelids temporarily affected by incautious exposure at too short a distance. Again, I have met with the complaint: "If I stare at an arc lamp for a long time it will make my eyes ache;" the obvious retort being: "Why should you stare at the light? If you do the same with the sun you will be equally inconvenienced." I may now name a few of the many additional pleasures of the eye we get from the use of the electric light. The flowers in our rooms do not fade away, and are seen in their true colours; our large pictures, and all coloured objects, are seen to better advantage. Again, the advantages to the health of our children are simply inestimable. No night lights, matches left about, or gas turned down low are required. A child of six years old can be trusted to press a button and so turn the light off and on; the lamps being high and out of reach are not easily broken or overturned, and the air of the children's nursery, even if the light be kept burning the night through, remains pure throughout. Another indirect advantage due to the absence of heat is that it is comparatively easy to thoroughly ventilate and cool during hot weather a room lighted by the electric light. The heat of gas placed high in the room causes such intense draughts when the windows are open that the discomforts and danger are almost worse than those from the heat and vitiated air, whereas in an electrically lighted room there is no difficulty in opening wide all the windows, the draughts produced being so gentle as to hardly be felt.

DISCUSSION.

The CHAIRMAN said it was very important in the discussion of any subject brought before a conference like that, after the matter had been fully put before the audience, that they should have representatives who would speak on both sides of the question, and therefore he trusted there were some present who, if not actual opponents of the electric light, might yet be considered as representatives of the present state of things.

Mr. J. S. ADAMS said there was one point which had been disregarded by the lecturer. In had become a truism that the electric light was an artificial means of illumination provided by nature, and that all other methods, including gas, were makeshifts. It was not sufficient to tell them this: they wanted to know, how is the adoption of a better or a perfect means to be brought about? Landlords could not be brought to fit their houses for the application of the electric light as they now did for gas, because they saw no prospect of an adequate return for the outlay. Nearly all the necessaries and unnecessaries of our daily lives were under the partial supervision of the Legislature, with the exception of artificial light; a house could not be tenanted unless certain regulations were complied with which rendered it habitable; in regard to the water supply, also, the Legislature laid down certain conditions for the various companies to observe; and he desired to know why artificial light was left outside all legislation.

Mr. SHOOLBRED thought Mr. Crompton was a little at fault with regard to the products of arc lighting. In the year 1879, when arc lighting was the only form in use of the electric light, some experiments were carried out by Mr. Evans, of the Chartered Gas Light Company, and the result of these, which were made with a large Siemens arc light, showed that from one hour of combustion a very small portion of nitrous acid was produced, and only an average of 5 grains of carbonic acid, which was about as much as would be produced by the respiration of one single being in the same atmosphere. Prof. Dewar, a few weeks afterwards, carried out similar experiments, and communicated the result to the Royal Society. A singular agreement was shown with the experiments made by Mr. Evans, a mean of 7½ grains of carbonic acid being obtained as against 5 grains in the other case. In either case the result showed a very small amount of vitiation of the atmosphere by the electric arc, whether in the formation of nitrous acid or of carbonic acid. Passing on to the other form of electric lighting, the incandescent, he might mention that there was an installation at the House of Commons, where they had a perfect comparison between the old state of affairs when gas was used and the present mode of lighting by means of incandescent lamps. The amount of the improvement under the new system both in the temperature and in the vitiating products in the room was remarkable. It was the habit in the House of Commons to take a very large number of temperature observations every hour throughout various parts of the building, not only in the House itself, but also in the various other rooms connected therewith, as well as outside. In one of the worst places, the reporters' room, which was a comparatively low room, the temperature went on increasing when gas was used, although outside it was falling considerably. In that same room now the temperature did not rise in anything like the same degree; but when it was remembered that in the House of Commons there was a very large system of artificial ventilation, constantly removing the vitiating products, it would be seen that the state of affairs there was far superior to what it was elsewhere.

Colonel MALCOLM said he should endeavour to pose as one of those who were contented with the state of things as they were. Mr. Crompton had given them a very able lecture, but it had all come out of books. He had brought together a mass of facts which might equally well have been provided by any member of the audience for himself. But he took it that very few would care to take the trouble to do so, whilst many would not be able to get hold of all the points and data which he had been able to collect. It was very clear that if the electric light was as safe and as easy to manage as he made out, everybody would clamour for it, and the electric light companies would be doing a large and a lucrative business; but apparently it was very clear to the authorities that it was not so, and they took as much care as possible that the thing should be very well regulated. The point he was going to submit to Mr. Crompton was this—was electric lighting safe in the house. He (the speaker) knew what gas could do; he knew it blew out windows, and played other tricks every now and again; but still that, like the recent dynamite explosions, principally affected the kitchenmaids. He once saw a table set on fire by electricity; that was in the hands of a very skilful electrician, and he desired to know if there was really any danger from the introduction of those tremendous currents of which they heard into their houses. Mr. Crompton also talked about the glare, and said that sun light did not produce an unpleasant effect upon the eyes; the only effect, he said, was to stimulate the eyesight and do it good, and the glare that was complained of with the electric light and with gas light also was different from the vitiating products of combustion. One cause of glare, he (Col. Malcolm) thought, was the very bright light emanating from a very small object. For his own part, if the sun streamed into his bedroom through a small crack, it had a very unpleasant effect upon his eyes; and he supposed that what was necessary with these bright lights of electricity was that there should be a lot of them, well disposed, so that the eye should not be attracted by any particular one.

Mr. OFFOR said he should not have ventured to take part in the discussion had he not been very recently engaged in a very important experiment in connection with domestic lighting—the installation carried out by the company of which he was manager at Colchester, where the electric light had been supplied to the public in a very similar manner to that in which gas was supplied. If the opponents of the new illuminant which they were interested in introducing were fairly represented by the remarks which had been made by, he supposed he might say, one actual sceptic and one very doubtful friend of the old system, he thought the interest of electric lighting was not likely to suffer very much. The argument used by the first gentleman who spoke, that the adoption of the electric light in houses would lead to the raising of the rents, was, although probably unintentionally, the greatest compliment that could be paid to the electric lighting interest, for if rents were to be raised because of it, that would prove incontestably that the electric light was a very great improvement indeed. But he would ask this question, did he apply the same principle to everything else in his house? Whether, for example, he would refuse to adopt a proper system of cleansing his cisterns for fear the rent should be raised when the landlord heard he was getting a purer supply of water in consequence of the change? The principle might be applied in the same way to everything, until at last, in order to get the lowest rent, we must take care that our houses were most offensive to health, and the most improper places for us to occupy. Therefore, he had disposed of the only objection that had been suggested. From the experience he had had for some time past, and more particularly during the last few months, his impression was that the public were never so eager to have the electric light in their houses as they were at this moment. The question that was asked, and he had been asked it hundreds of times since that exhibition had been opened, was "Why can't we have the electric light?" And for the information of some gentlemen present he would quote from memory a letter which he received only a few days before from an inhabitant of South Kensington, who wrote to say, "We are anxious here to have the electric light, but we can't get it. A provisional order has been granted to a company for the purpose of lighting South Kensington. Can't you induce the company to part with it to you for a consideration, and give us the electric light?" But there were practical difficulties, which would be recognised at once by those present; and it was to get over these that the installation at Colchester had been carried out. Much as people wanted it they were not prepared to put down an electric light plant in their houses. If a wire could be brought into a man's house as gas companies introduced a gas pipe, and his electricity given him in the simple way he got his gas, charging him so much per quarter for the electricity he used, then any amount of business might be obtained as electric light suppliers. But the practical difficulty was, how was this to be done? In London streets, for example, where were the houses where, even if there was the desire, accommodation could be found for steam engines, dynamo machines, storage batteries, &c. Then it would have to be supplied by means of central stations; and that was just what was being done at Colchester. He really thought they were engaged in killing a dead donkey over again when they got up to address an intelligent audience on the subject of the superiority of the electric light with respect to health; its superiority was admitted on all hands. It was now a question of whether the electric light could be supplied at the equivalent of 3s. a thousand feet of gas, or of 4s. or 5s. If men would only know that they could save their doctor's bills and their upholsterer's bills; if, as a well-known universal caterer told him a short time ago, he could save £500 a year in whitewash alone in his establishment, they must know that it would not be a question as to whether the electric light would cost just the same as a similar amount of gas. The practical question was, could it be supplied in a convenient way? The experiment at Colchester had proved perfectly successful. There they had a central station where the current was generated by means of dynamo machines; then in different parts they had stations where the current was stored, whence it was

supplied to the houses by small wires just in the same way as gas was supplied. They had solved the problem; but it must not be supposed that there was nothing to be done on the part of the public. If they wanted the light they must be prepared to supply the money in order that the new illuminant might be provided by those who knew how to provide it if the means were placed at their disposal. If the public would not find the money to purchase the plant it was no use expecting that the plant would be supplied. The gas interests had an enormous amount of capital, with which they were supplying the public. Now that the public could ascertain for themselves that the electric light could be supplied, and with all the advantages of which they had heard, then, if they had faith in their opinions, to subscribe the funds, there were gentlemen on the platform who would soon have the metropolis well lighted with the electric light.

Mr. SWAN said he could give a very direct answer to Colonel Malcolm as to the safety and simplicity of the electric light. His own house had for some time been fitted with incandescent lamps, and was under the control of servants just as gas light ordinarily was. There had not been a single accident, and the lighting had been most perfectly done without a single hitch or any kind of discomfort; in fact, more comfort than could have been had with gas light or oil lamps. The gentleman who followed Mr. Crompton suggested that it was the duty of the Legislature to see, if the electric light was such an advantage, that the public had it, and that they were secured. He seemed to have the idea that the matter had been neglected both as to the electric light and artificial light altogether; but the truth was that the Legislature had interfered both in regard to the supply of gas and of the electric light. The Legislature took care when it granted powers to gas companies that the gas supplied should be of a certain quality, both as to the absence of sulphur and other deleterious things separable from gas, and as to the illuminating power of the gas; and so the public were protected in that respect. The Legislature had attempted to do the same recently in regard to the electric light, but, he was afraid, in a most unhappy way. With every intention to help forward the introduction of the electric light, an Act of Parliament had been passed to protect the public, on the one hand, against extortion and other evils that might possibly grow out of a monopoly, and, on the other hand, to give encouragement and protection to the companies that might invest their capital in the endeavour to supply the public with the improved form of light. That Act of Parliament had not been successful; it did not sufficiently recognise the fact that the electric light was an infant and needed nursing carefully more than for a straight jacket to be put upon it. The discouragement caused by that Act was one of the reasons why at the present moment no more had been done in the direction Mr. Offor said his company was pursuing at Colchester. He thought it would not be at all a bad thing if one practical outcome of that conference were an endeavour to obtain some alteration in that Act so as to make it better worth the while of the companies to give the electric light. It was perfectly evident, from what several speakers had said, that the public were clamouring to have the light; they knew it was a vast improvement on gas light. He (Mr. Swan) had had a similar experience to that of Mr. Offer, for the previous evening he was asked why the electric light could not be obtained. He pointed out the difficulties the companies had to contend with in the face of that Act of Parliament, which over-protected the public and did not afford a sufficient temptation to capital to invest.

Mr. CRAMPTON said the Act of Parliament which had been alluded to had a very curious clause in it. It seemed that a company might go on through all kinds of vicissitudes for several years, but when it commenced to make any headway, or achieved success in a town or district, the authorities could purchase its rights—not upon fair conditions of so many years' purchase, but simply at the cost of the material on the ground. No progress could be made under such conditions.

Mr. GREENHILL mentioned the case of a gentleman in Scotland who had used the electric light in his honse for two years and a-half, and who said that if it cost five times as much he would not discard it. Another gentleman at Stockton-on-Tees said if gas was offered him free of all cost, he would not abandon the electric light. He believed electric lighting was now established on a sounder basis than ever, and was perfectly certain that in a very short time it would become general.

Mr. WILLOUGHBY SMITH remarked that he was at first greatly in favour of the electric light, until one of his neighbours took it into his head to light his house by electricity, and now he thought it one of the greatest nuisances possible, for the noise from the machinery, and especially from the "silent" gas engine, was almost intolerable.

Mr. CROMPTON said one of the objects of that conference was to bring again, very strongly, before the public the fact that the electric lighting possessed the clearest advantages with regard to health. One of the reasons why the electric light was not more generally used was because people would not pay for it at present; they either would not buy the companies' shares, or would not pay for individual instalments in their private houses. But if they kept hammering away and told people that they were slowly poisoning themselves they were bound to give in at last. He should, indeed, be flogging a dead horse, if he were to keep reiterating the safety of the electric light; the great danger avoided was the absence of any necessity for the use of matches, and in every respect the danger was infinitesimal. He had never yet heard of a single accident occuring from the use of the incandescent light. Alluding to the complaint of Mr. Willoughby Smith, he said the noise was one great objection to private installations, and very few people had the necessary accommodation for the engines and dynamos; he had succeeded in making his engine fairly silent, but a great amount of care was necessary, and yet the only means of supplying power which the insurance companies would allow inside London was by these gas engines. He hoped that meeting would be duly reported, and that the public would be made aware that the electric light was not dead, but recovering from a severe sickness caused by the rush to make money on it in a speculative manner, comparing exactly with the rush to make money on railways in the days of Hudson. The rush was now over, and the manufacturers were doing their best to get over the mechanical difficulties, so that all that was now wanted was the confidence of the public, who might band themselves together into larger or smaller companies for the lighting of their own particular districts.

The CHAIRMAN said it was quite necessary to enforce ideas which were, perhaps, very well known in certain quarters, but which were not sufficiently generally known. He was glad, indeed, that Mr. Crompton had made it known that the companies were perfectly ready to undertake installations, and he hoped that remark would go forth to the public. He moved a vote of thanks to Mr. Crompton, which was heartily accorded.

THUNDERSTORMS.

ON the three closing days of the week ending July 5th thunderstorms of more than ordinary violence passed over England and Scotland. Reports show considerable loss of human life and destruction of property. The storms were accompanied by heavy showers of rain and hail. Some of the hailstones, when picked up, were found to measure seven-eighths of an inch square, and weigh over two pennyweights.

SUMMARY.

ENGLAND.

Aston, near Wallingford.—Two men, while working in a field, were killed. Their clothing was completely consumed. A horse in the neighbourhood was also killed.

Burnley.—Two men were seriously injured.

Liverpool.—At Holy Trinity Church the lightning passed through the roof and through the gallery floor, filling the building with a pale blue flame. The current passed between two boys, paralysing the arm of one, and scorching the boot of the other. The bell was rendered useless, and coping stones were hurled some distance.

Peterborough.—A number of sheep and cattle killed.

Weardale.—Wesleyan Chapel struck, and two men at work on the spire were knocked down insensible, but recovered consciousness afterwards. At Burn Hope a house was partially destroyed.

Northampton.—Lightning struck several dwelling-houses, demolished the turret of a shoe factory, and injured a girl.

Wymeswood.—Three men, who were at work in the hay field, took shelter under a hedge. One of the men felt a sharp pain on his thigh, and became insensible. On recovery he found that one of his companions had fallen, while the other was sitting, looking placid, and apparently undisturbed; but on examination he found both were dead.

Skipton.—Tree struck and cut, and a cartload of hay which was being put into a barn set on fire.

Wingham.—A stable on the farm of Sir Brook Bridges was struck by lightning and set on fire, three valuable horses being burnt to death.

Cambridge.—A woman was killed, and several buildings were struck by lightning.

Deddington.—A painter was killed whilst sitting under a tree during a thunderstorm.

Consett.—Whilst nursing an infant on his knee a miner was struck by lightning and killed, the child escaping.

SCOTLAND.

Hamilton.—The storm, which was at its height about half-past one, continued for fully two hours. About half-past one o'clock, what is described as a ball of fire, burst over the Clydesdale Bank, a large three-storey structure in Cadzow Street. The lightning struck the chimney head, racking and displacing the solid stonework, and passing, it is believed, down the chimney. The consternation of the inmates, including the officials of the bank, may be conceived. In the room with which the vent communicated, the grate was thrown out on to the floor, and the apartment filled with soot, plaster, and debris. Something similar happened in the room on the second floor. The bank office is immediately below on the street floor. The accountant was startled by the noise and falling debris. Mr. Lightbody, who was standing inside his shop door on the opposite side of the street, was almost knocked off his feet against the side of the door. His workmen in the bakehouse behind thought the premises had been struck, and the beam and scales were knocked against the wall. The tailors in Mr. Park's workshop, which adjoins the bank, felt stunned, and thought their skylight window had been struck. Three independent witnesses standing in the neighbourhood at

the time state that they noticed a ball of fire momentarily suspended over the bank.

Lockerbie.—Several houses struck and their roofs damaged.

Kilbirnie.—Two houses damaged; the lightning passing from the one to the other.

Beith.—Intense darkness accompanied the storm, and business had to be suspended for fully an hour, during which time flash succeeded flash at intervals of four minutes.

Ardrossan.—The most severe storm ever experienced. The flashes of lightning were very vivid, and the peals of thunder sharp and loud. Hailstones, weighing over two pennyweights, and measuring three-quarters of an inch in circumference, were picked off the streets.

Saltcoats.—Two houses struck, and their gas pipes cut in two.

Kirkintilloch.—The lightning entered the room of a house, passed along the attics and out by the chimney, shattering the plaster and chimney top.

Rothesay.—Valuable milch cow killed.

Vale of Leven.—Darkness intense. The flashes of lightning very vivid, and the peals of thunder, which were loud, continued from 10 to 20 seconds.

Stonehouse.—Hailstones of large size, vivid lightning, and a series of tremendous sharp, loud, and prolonged peals of thunder. Cow killed and a tree struck.

Newmilns.—Thunder peal following thunder peal in rapid succession, and sometimes three of them were heard at the same time. Outside stair and belfry of the Council Chambers damaged.

Loans.—Two cows and a bull killed.

Sinclairtown.—Dwelling-house struck, followed by an explosion of gas; damage not serious. Stack of hay set on fire and completely destroyed.

Kirkcaldy.—Ventilator at the top of malting kiln at Gallatown struck, and one of the large beams supporting the ventilating apparatus shattered, some of the splinters being carried away a distance of about 200 yards. In a private house a valuable picture was destroyed, and the woodwork set on fire.

Stanley.—A house was set on fire, and a portion of the structure knocked down on two women, rendering them insensible for a time.

Stow.—Eight sheep instantaneously killed, and a ninth had to be afterwards destroyed.

Hawick.—The storm lasted for upwards of two hours, and so dark was it, that gas had to be lighted. The lightning entered two houses and damaged a number of articles.

Girvan.—Several cattle killed.

Busby.—The lightning was most brilliant and vividly coloured, blue in many instances. From three to four flashes were seen before thunder heard. Three girls employed in Busby Mills fell into a state of fainting, and remained in a trance for several hours. A cow grazing in a field was killed, its hide being singed. A building in the printworks was stripped of the lead and slates.

Ayr.—The lightning very bright and the thunder almost incessant. Several of the flashes were of a violet tinge. Some little panic was created in Ayr Wool Works by the girls getting frightened at the lightning gleaming on the spindles.

Leith.—The lightning entered a house, ran round the cornice of a room, tearing it open. The window curtains were set on fire, the roof singed, and a number of articles which were lying about damaged. The lightning escaped through the window, scorched the framework and smashed several panes of glass. A gentleman sleeping in the room had a very narrow escape, as the lightning in its course went within a few feet of his head; he was much shaken. After leaving the house the lightning had, judging from a quantity of plates dislodged, run down the outside of the house and entered the earth.

Edinburgh.—The *Scotsman* says: "Just as the storm began one of the telegraph clerks in the *Scotsman* office had a narrow escape from being injured by the lightning. Word had come over his wire that the House of Commons had been counted out at 2·30 a.m., and he rose from the Morse instrument to carry the sheet into the adjoining sub-editor's room. As he re-entered the telegraph room a loud report like the discharge of a rifle was heard, and the thick glass cover of the relay was blown several feet into the air and smashed one of the glass globes. The relay was completely destroyed."

Dumfriesshire.—Reports give accounts of considerable destruction of farm stock. Mr. Phillips, Clarencefield, had two fine bullocks killed, Mr. H. Baird, Blackford, had one killed, and Mr. Aitken, a farmer in the parish of Johnstone, had 16 sheep killed. While a lad was harrowing turnips in a field the lightning struck the ground in the next ridge, and covered him with earth, and a man leading a horse had a very narrow escape, he having just passed when a large tree was struck and thrown across the road. Heavy rain accompanied the storm.

Arisaig.—Mr. Lewis Macdonald (28 years of age), crofter, Ardnish, was on the hill above the croft, taking home the cattle at about 4 p.m., on Friday last week, when he was struck with lightning and killed instantly. When found it was discovered that there was a mark like a bullet hole on the right side of the head above the ear, and from the appearance of the body it is evident that the electric fluid struck his head first, and then passed through his body.

Appin.—There were several extremely vivid flashes of forked lightning passing straight down from a dense cloud overhead to the earth. Four sheep were struck by lightning and killed; and altogether the storm was one of the most severe remembered for some years.

EXPERIMENTS ON THE EFFICIENCY OF INCANDESCENT ELECTRIC LAMPS.

SOME experiments made by Mr. Horace B. Gale in April and May, 1883, when a student in the Massachusetts Institute of Technology, have been contributed to Van Nostrand's Magazine.

The object of the tests was to ascertain the efficiency of each of the principal forms of incandescent lamps when run at various candle powers. The efficiency, as the term is here employed, is measured by the number of candle lights produced per horse power of electrical energy expended in the lamps themselves.

The forms of lamp tested were the Maxim, the Edison, and the Bernstein. Measurements of the Swan lamp, which it was intended also to include, had to be omitted on account of the limited time which could be spared for the work.

The heat escapes from the carbon filament in three ways: first, a little is conducted away by the connecting wires; second, a still smaller amount, probably, is transferred to the glass by the rarefied gas left in the globe; third, the remainder, which represents practically the whole energy expended in the lamp, escapes from the carbon by radiation. This radiation consists partly of invisible heat and partly of light; and it is clear that the most efficient lamp is the one in which the largest part of the radiant energy is in the desirable form of light. In other words, the efficiency of an incandescent lamp depends solely upon the proportion between the quantity of energy which is given off as light, and that which is wasted as invisible heat.

Now the ratio between the quantity of light radiated and the quantity of heat radiated by any solid body, depends upon its temperature. The shape or structure of a body, or the extent of its surface, though influencing the total amount of radiation, cannot affect the proportion of the light and the heat.

By adjusting the strength of the current passing through the carbon of an incandescent lamp, we may heat it as hot as we please. We may raise it to a moderately high temperature without getting any light at all, all the energy expended being wasted in the form of heat; increase the quantity of electricity passing through the filament, and we can bring it to a dull red; again augment the current, and it glows with a feeble yellow light; and now, if the current is made a little stronger, without adding much to the amount of *heat* radiated, the intensity of the *light* becomes enormously increased. The way in which the candle-power rises, as the current strength is augmented, may be seen in the following table, based on a series of measurements made upon a Maxim "B" lamp, designed to give about nine candle-power.

Current strength in ampères.	Candle Power.	Increments of current strength.	Increments of candle-power.
0·	0·		
0·5	0·	0·5	0·
1·0	(very dull red)	0·5	0·
1·5	3·5	0·5	3·5
2·0	17·0	0·5	13·5
2·5	55·0	0·5	38·0
3·0	120·0	0·5	65·0

The efficiency of a lamp, that is, the return we get in light for a given amount of electrical energy being greater, the higher the degree of incandescence to which the carbon is brought, it follows that by varying the candle-power of any incandescent lamp, we may, within certain limits, make its efficiency as high, or as low, as we choose. On the other hand, the hotter the carbon is heated the sooner it is disintegrated and destroyed. A gradual transfer of particles of carbon takes place from the filament to the inner surface of the glass globe;

the latter becomes darkened, the resistance of the carbon is raised, and finally the filament breaks at its weakest point.

It is worth noting in this connection, that in the experiment referred to above, the Maxim lamp was run for about fifteen minutes at more than ten times its normal candle-power without apparent injury, a fact which speaks well for the endurance of this form of lamp.

While the *efficiency* of an incandescent lamp is thus a matter of temperature, chiefly, being greater the higher the temperature, its *durability* depends both upon the temperature and upon the form, structure, and density of the carbon, as well as upon the perfection of the vacuum obtained in the globe. The *relative economical importance* of the efficiency and the durability of a lamp will vary, of course, in different circumstances, according as the cost of the power, or the cost of renewing the lamp, is the greater; and if we can discover the law connecting the efficiency, length of life, and candle-power of a given form of lamp, we can determine, for each special case, at what candle-power the lamps should be run in order to obtain the greatest economy.

The peculiarities of the various types of incandescent lamps depend mainly upon differences in the carbon filament.

Three styles of Maxim lamp were used in these experiments, rated respectively as 12, 24, and 16 candle-power. They were taken at random from a large stock on hand.

Three varieties of Edison lamps were experimented upon, rated as 8, 10, and 16 candle-power. These lamps were sent from the factory of the Edison Company at Newark.

The Bernstein lamps used in these tests were peculiar in many respects, perhaps the most striking peculiarity being their very low resistance. The carbon consisted of a straight hollow tube, about an inch and a quarter long, of the size of a straw, and terminated by two knobs or bulbs of carbon about a quarter of an inch in diameter, into which the ends of the connecting wires entered. These lamps were obtained from the factory in Boston. They were rated at 30 candle-power. As they had scarcely passed their experimental stage, and have since been improved, the results obtained from them are not presented here as fully as are those obtained from the Edison and Maxim lamps.

The following table shows the resistance of the various lamps when cold:—

RESISTANCE OF EDISON LAMPS, COLD.
(Temperature of room, 68°).

10 candle lamps.	8 candle lamps.	16 candle lamps.
Ohms.	Ohms.	Ohms.
No. 21, 380·0	No. 16, 125·0	No. 11, 300·0
„ 22, 377·5	„ 17, 111·0	„ 12, 300·0
„ 23, ——	„ 18, 114·0	„ 13, 291·0
„ 24, 384·0	„ 19, 107·0	„ 14, 268·0
„ 25, 396·8	„ 20, 108·5	„ 15, 297·5
Average, 384·58	Average, 113·10	Average, 291·30

RESISTANCE OF MAXIM LAMPS, COLD.

24 candle (A) lamps.	B-lamps. ("half-lamps.")	16 candle lamps.
Ohms.	Ohms.	Ohms.
No. 1, 75·0	No. 30, 34·0	No. 41, 148·3
„ 2, 74·6	„ 31, 32·2	„ 42, 149·2
„ 3, 74·4	„ 32, 34·7	„ 43, 148·3
„ 4, 76·0	„ 33, 35·0	„ 44, 150·0
„ 5, 75·4	„ 34, 34·3	„ 45, 153·4
Average, 75·08	Average, 34·04	Average, 149·84

RESISTANCE OF BERNSTEIN LAMPS, COLD.
30 candle lamps.

No. 1	4·37	Ohms.
„ 2	6·47	„
„ 3	1·83	„
„ 4	1·42	„
„ 5	—	
Average...	3·52	„

The measurements of candle-power were made upon a photometer of the ordinary Bunsen type, having a bar 100 inches long. The disc was inclosed in a box about a foot long, having an opening in each end to admit light, and two mirrors so arranged that both sides of the disc could be viewed at once from an opening in front. The box carrying the disc could be rolled on wheels along a horizontal track, and a pointer projecting downward opposite the disc indicated on a graduated scale the ratio of the intensities of the two lights at the two ends of the bar. The whole was placed in a dark room, the interior of the room, and also the apparatus itself, being painted a dull black.

On account of the shape of the carbon filament, incandescent lamps generally give more light in certain directions than in others; and it is important to know exactly what the variation is, so that we may calculate, from a single measurement of the intensity of the light in a given direction, what is the true average candle-power of the lamp. This point was accordingly investigated for each one of the lamps. The method used was to place two lamps of the same kind, connected either in series or in multiple arc, at opposite ends of the photometer bar, and send a current from the same source through both. One of the lamps was then turned about its vertical axis through 10°, or less, at a time, as indicated on a graduated circle, and the intensity of the light given off at each angle was compared with that of the other lamp, which remained fixed, and served as a standard.

The principle advantage of this method is, that if any accidental variation in the current should cause the candle-power of the lamp tested to vary slightly from its normal value, the brightness of the standard lamp will vary in the same way, so that the ratio of the candle-powers will not be affected. It was found that in this way these experiments could be carried on equally well with a current of variable intensity as with a steady current. In all the tests here described, however, the current was kept perfectly steady.

The values of the illumination of each lamp at the different angles were laid off graphically from a center, and a curve drawn through the points thus found. The area of each curve was then measured with a planimeter, and the ratio of the true candle-power to the candle power as measured on the face of the carbon loop (*i.e.*, perpendicularly to its plane) was computed for each lamp. The average results for each class of lamps were also plotted in the same way.

The photometric measurements were made only in a horizontal plane, because that is the usual method of measuring candle power, though perhaps a fairer comparison of the different lamps would be arrived at by taking the average spherical illumination.

The carbon of the Maxim lamp, being made from paper, is several times as broad as it is thick; hence we see that the illumination opposite the face, or flat of the carbon is considerably greater than that on the edge. The variation in brilliancy, as we go from the edge round to the face, is extremely regular for the Maxim lamps, the curves of the individual lamps being almost identical.

In the Edison lamps the carbon filament has its greatest breadth in the direction perpendicular to the plane of the loop, so that the illumination is feeblest on the face, and increases as we go toward the edge. Just in the plane of the loop, however, there is a sudden falling off in the intensity of the light; because when the two arms of the filament are exactly in line, one cuts off the light of the other. Though these curves, each showing the average of 5 lamps, are tolerably regular,

the curves for the individual Edison lamps are quite irregular, owing to the carbon being more or less twisted.

The illumination of the Swan lamp, one of which was tested at this time, was found to be the most uniform, being practically the same in all directions. It is claimed, however, that a uniform illumination is not always an advantage, as it is often desirable to be able to throw more light in certain directions than in others.

For experimenting upon incandescent lamps, it is desirable to be able to maintain, for any length of time, a perfectly uniform and steady current of electricity. The available sources of current were in this case a Weston 15 arc light dynamo machine, having the field in derived circuit, and a Kabath secondary battery of 72 cells. The current of the dynamo machine, though tolerably steady, was not perfectly so, on account of slight variations in the speed; and that from the storage batteries, though not subject to fluctuations, would nevertheless run down gradually as the cells became discharged. By using the machine and the battery in combination, however, it was found possible to maintain a current of a perfectly uniform intensity for any desired time. The batteries were connected in series, so that any number of them might be placed in the circuit of the dynamo machine, in derivation with the loop supplying the lamps. The current passing through the lamps could be regulated by means of an adjustable resistance, or by varying the number of cells of the battery in circuit; and a variable resistance was also interposed in the field circuit of the dynamo, so that its electromotive force could be adjusted to just balance that of the battery. The dynamo thus supplied the current to the lamps without exhausting the battery, which merely served to keep the electromotive force on the lamps constant, and to absorb any fluctuations that might exist in the current of the dynamo. When the lamps were turned off, the dynamo merely supplied the loss due to leakage and local action in the cells. This arrangement of balanced electromotive forces is, of course, not possible with a dynamo having the field coils in direct circuit.

Measurements of current were made by means of one of Ayrton and Perry's ammeters, which was carefully calibrated at intervals during the progress of the tests by comparison with a tangent galvanometer.

REVIEW.

Practical Electric Lighting. By A. BROMLEY HOLMES. Second edition. London: E. & F. N. Spon, 16, Charing Cross.

The opportunity which the author has had of adding to his original work, through the medium of a second edition, has been taken advantage of; the result has not, however, been entirely satisfactory. The writer in his new preface draws special attention to the fact that a chapter on "Secondary Generators" has been added. In writing this chapter Mr. Holmes has either simply copied the statements of the inventors, without considering whether they are correct or not, or he has written on a subject which he does not understand. Thus on page 150 we have the following:—"One point in this system of distribution deserves special attention, namely, that the strength of current in ampères for a given circuit having once been determined upon, and the requisite dimension of cable settled, any increase of working current necessary at the distributing stations is obtained by the increase of the electromotive force of the main circuit current, and by not increasing its ampère strength. In this way the waste in the conducting cable (calculated by the formula $W = C^2 R$) remains constant, however much the useful work at the distributing stations may be increased. This is a manifest advantage over the ordinary systems of supply, where the waste in the conductors increases with any increase in the number of lamps." The latter paragraph affords us a piece of information of which we were in ignorance until now; we did not know that a number of lamps joined in series required more current to pass in circuit, that is through the leads, than would be the case if only one were in use; but we live and learn.

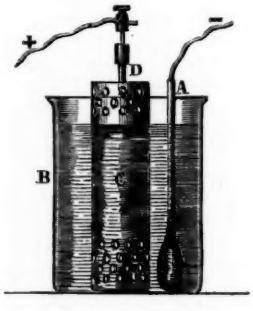
NEW BATTERY WITH AN ALKALINE LIQUID.*

THE alkaline liquid batteries, and especially that of MM. Lalande and Chaperon with oxide of copper have latterly attracted the attention of electricians.

The inventors have undertaken to render their battery as practical as possible so as to render it fit for industrial and scientific uses.

Whilst admitting the merits of this battery we are persuaded after prolonged experimentation that the oxide of copper may be advantageously omitted, taking as the positive pole of the battery retort—carbon broken into small fragments. Although it is not easy to suppose any true chemical action taking place in the carbon, yet experience has shown us that a positive element thus formed is polarised only with great difficulty, so that it may be usefully employed in our battery, even when kept for a long time in action with a closed circuit.

The form which seems to us the best for our battery resembles that of the Leclanché element.



The zinc, A (see figure), which must be carefully amalgamated, is immersed in a solution of caustic potash contained in a glass vessel, B.

The positive pole is in the middle, and is formed of a cylindrical vessel, C, of very porous earth, the sides of which are perforated with a large number of holes large enough to let the liquid penetrate without allowing the fragments of carbon contained in the same vessel to escape. In the centre is placed a small rod of carbon, D, which serves as an electrode, and for which may, without inconvenience, be substituted a plate or a stout wire of copper.

As soon as our battery is set in action it develops a considerable electromotive force, which may sometimes amount to 1·60 volts, but this electromotive force then decreases very rapidly down to a limit, which depends on the resistance of the circuit as compared with the magnitude of the battery. With an external resistance of a few ohms we obtain a permanent action differing very little from 1 volt.

Nevertheless the great power of this battery, as of that of MM. Lalande and Chaperon depends, on the low internal resistance which renders it possible to obtain very intense currents with relatively feeble electromotive forces. But even in this respect it seems to us

* Professors Fabri and Ravaglia in *La Lumière Electrique*.

advantageous to substitute carbon for the metallic oxides which have a weaker conductivity.

We are studying, at present, the most practical manner for regenerating the alkaline solution so as to utilise the products of the decomposition of the zinc (?) and we hope shortly to present to men of science, and to industrialists, a battery convenient and economical, both as regards the first outlay and the working cost, and which may be advantageously substituted for the Leclanché battery.

Already, for some time, a battery on our system has been applied to the fire alarm apparatus at the Alighieri Theatre at Ravenna, and, so far, the instruments attached to this apparatus to give warning of any decline of action in the battery have not indicated any need for setting in action a reserve battery which is always kept ready in the theatre.

Finally, we purpose continuing our researches in order to ascertain what is the action of the carbon in our battery. Researches which may possibly lead to the explanation of other phenomena presented by batteries with solid depolarisers, and which may present some scientific interest since it is certain that, on setting out from the calories corresponding to the formation of the oxide of zinc, and to its combination with potassa, and taking into account the hydrogen set free at the positive pole, we obtain for the electromotive force a quantity of heat strikingly inferior to that which results from the measurement made directly at the battery.

This may, in part, depend on the large surface presented by the small fragments of carbon in proportion to the zinc, but it seems to us that this does not suffice for the complete explanation of the phenomenon.

The absorbing power of the carbon for the oxygen of the air being much superior to that of the hydrogen produced by the chemical action of the potash upon the zinc may, perhaps, contribute to increase the electromotive force of the battery.

NOTES.

Electric Lighting.—Mr. W. T. Grimley's old established house, in Manchester, better known as Larard's Still, is just now undergoing extensive alterations and additions. As it is proposed by the enterprising owner to make this one of the finest places of its kind in the North, it has been decided to light it throughout with the electric light, to drive which an Otto 8 N.H.P. gas engine will be put down. The lighting will consist of both arc and incandescent lamps driven off separate dynamos.

Mr. Chamberlain stated in the House of Commons on Thursday, the 10th inst., that 120 applications for provisional orders have been made to the Board of Trade since the passing of the Electric Lighting Act. Of these 73 have been granted by the Board of Trade and confirmed by Parliament. There have been ten applications for licences. One for Colchester was to be granted in the course of a few days. The remainder have not been proceeded with by the applicants. The supply of electricity has not been commenced under any of the orders.

An installation of electric lighting on the Weston arc system, supplied by the Maxim-Weston Electric Company, has for some time been in operation at the New British Iron Company's Corngreaves Iron Works, a large concern near Birmingham. The lighting has been so satisfactory that it has been decided to double the installation, with the view, if possible, of dispensing altogether with gas light in the works. The two installations will be driven from separate engines and dynamos, so that should either of them fail the other will continue to light the works sufficiently until the necessary repairs are made; the alternate lamps throughout the works being connected with alternate dynamos. Messrs. Tangye, Limited, are supplying the New British Company with one of their vertical engines for driving the dynamos, and Messrs. Bagshaw and Sons, of Batley, are supplying the turned wrought-iron pulleys for the countershaft used to get up the speed—viz., about 1,000 revolutions per minute. The lamps and leads are being erected by the Maxim-Weston Company.

That electric light stocks in America are more remunerative as an investment than in this country is evident from the following extract from the Boston *Globe*:—"The rapid development of electric light business throughout the United States is attracting the notice of capitalists generally as a chance for a legitimate investment above the average business investment of the present time. It is said that the original investors in many electric light companies are getting 40 per cent. on their stock. The New England companies have paid 10 per cent. since their organisation."

The fine new steam yacht *Electra*, of Mr. Elbridge T. Gerry, states the *Electrical Review* of New York, has been placed in commission. She is lighted by the Edison Company, and will have, it is said, about 60 lamps. The masthead light at sea will be an incandescent cluster lamp of 100 candle-power, visible 10 miles away. The port and starboard lights will also be brilliant incandescent lamps.

On a recent occasion in Paris some firemen had occasion to go into the cellar of a burning building, and carried ordinary lanterns in order to see their way. It chanced that, as one of the results of the fire, there had been a break in the gas main, and the accumulation of gas in the cellar was such that an explosion took place as soon as the men entered the cellar, killing and wounding a number of the firemen. There was an investigation, and the result is that firemen are now provided with electric lamps supplied by portable storage batteries, and when it becomes necessary to enter a building or room in which the presence of gas is suspected these are used exclusively.

The Clevedon (Somerset) Local Board invites tenders for the public lighting of its district for nine months commencing August 15th, either by electric light, oil, or otherwise. Tenders to be sent to Mr. H. C. Fry, clerk, by the 29th inst.

The steamer *Thistle*, belonging to the Glasgow and Londonderry Steam Packet Company, has been fitted with the electric light by the Pilsen-Joel Electric Light Company, of London, under the superintendence of Professor Jamieson. The installation includes 41 lamps, each of 20 candle-power, distributed over almost the whole of the ship, including the steerage and cattle holds. In all cases the lamps are enclosed in ground glass shades or wire frames, and in the portion of the ship set apart for the first-class passengers, the lamps are fitted both in the saloon and the adjoining state rooms. There are in all 17 lamps in the saloon circuit; there are 10 lamps in the steerage circuit, which includes the engineer's room and chart room on the upper deck adjoining the engine casing. For the cattle holds there are two circuits, so that if goods rather than cattle are being carried, one or both of them can be cut out at pleasure. In each of these circuits there are four lamps. The rest of the lamps—six in number—form the engine-room circuit. The dynamo used is of the Schuckert type, manufactured by the Pilsen-Joel Company. It develops an electromotive force of 102 volts, and supplies each lamp with ·66 ampères, or a total of 27·2 ampères for the 41 lamps. The speed required, which has been made low in order to suit ship lighting, is 450 revolutions per minute. The engine, which is direct-driving, is of the Westinghouse type, and has been manufactured by Messrs. Alley and M'Lellan, Glasgow.

It was recently announced that the Government at Melbourne had accepted the tender of the Australian Electric Company for lighting the two Legislative chambers, the vestibule, and the library in the Parliament Houses, at a cost of £5,062, the only

other tenderers being Messrs. W. H. Masters & Co., the amount of whose tender was not disclosed. Messrs. Masters & Co. were the first to introduce the electric light (the Edison system) into the Parliament buildings, and they now complain that the higher tender has been accepted, theirs being £588 5s. lower than the amount stated above. In justification of their protest against the gross injustice they claim to have been subjected to, they say that they have already lighted the Council Chamber for part of one session without payment, the Council being so well satisfied that they requested them to continue lighting the chamber during the last session, for which they received £2 10s. per sitting, and no complaint of any kind was received.

The city of Rouen has organised in connection with the Concours Regional an exhibition of electricity for the whole of France, and a special exhibition of Algerian products. The number of electrical lamps, regulator and incandescent, is very large—about 400 Swan, some Maxim, 30 Breguet regulators, about 30 Jablochkoff, and 5 or 6 sun lamps.

The Neptune Brass, Copper, and Iron Works of Messrs. Mechan and Sons, Glasgow, have been partly lighted by means of electric lamps, Six Paterson and Cooper J.F. arc lamps of 2,000 candle-power each, and two dynamos by the same firm are employed.

Messrs. Denny Brothers & Co., of Dumbarton, have had seven similar lamps installed in their engineering shop to replace some Brockie arc lights. A Gramme machine generates the current, and both this and the foregoing installation have been carried out by Paterson and Cooper's Scottish agent, Mr. James Campbell, of Glasgow.

The electric light was used for two dances given by Mrs. Mendl at 39, Holland Park. About 30 lamps were employed in connection with 30 1-H.P. Faure-Sellon-Volckmar cells. The lamps used were Messrs. Woodhouse and Rawson's new filament type, this firm supplying all the plant; Mr. E. Manville looking after the erection and general arrangement.

Telephony in New Zealand.—According to figures just published, the Postmaster-General of New Zealand reports that at the close of 1882 the total number of telegraph stations connected by telephone was 66. The exchanges at Auckland, Christchurch, and Dunedin had a total of 417 subscribers. Wellington had 57.

Telephony in Germany.—An interesting table of German telephone statistics has appeared, showing what has been done in the German Empire by the post office, in whose hands is vested the sole control of the telephone. At the end of 1883, there were 5,851 telephones connected—or 6,182, if we include those fixed in telegraph stations for the telephonic dispatch of messages received there—or, in all, states the *Electrical Review* of New York, only about as many in the whole of the Fatherland as there are in the two cities of New York and Boston.

The Telephone in Brooklyn, N.Y.—The city of Brooklyn has granted to the New York and New Jersey Telephone Company rights on the fire telegraph poles, provided it keeps the line in good order, and furnishes the city, free of expense, 100 telephones and 35 exchange connections.

Telegraphic Communication in Shetland.—The Shetland Telegraph Extension Association is evidently full of vitality. Not satisfied with the information that "a rule has been passed by the Treasury, obliging the Postmaster-General, before further extensions are made, to require an annual guarantee for seven years of such sum as will in each case insure the Post Office against loss," which for ten places mentioned in the memorial amounts to over £1,500, it has addressed a vigorous memorial to the Treasury Lords. The petitioners submit "that while it is of the utmost importance to the inhabitants of Shetland, and absolutely essential for the further development of the fisheries and the general prosperity of the islands that the means of telegraphic communication be extended to the places mentioned, yet the guarantees required by the Postmaster-General are largely beyond what it is in the power of the several districts to provide." They therefore pray that the amount of guarantees be reduced. In favour of their contention the advantages of developing the fishing industry; the forming and nursing fishing grounds, and the plea that the telegraphic system is a national institution the advantages of which should be extended to every part of the nation, are urged.

Extension of Telegraphic Communication.—Mr. Courtney, in answer to Mr. Barclay, in the House of Commons, on Friday, the 4th inst., said that the main recommendations of the Crofters Commission in favour of increased telegraphic facilities in Orkney and Shetland had already been anticipated under an arrangement with the Fishery Board. Looking to the unremunerative character of the telegraph service at home, it was scarcely possible to dispense with the guarantee now required before providing such telegraphic communication.

The Marquis of Lorne, Sir John Orde, and Mr. Peacock Edwards, representing Lady Cathcart, recently waited on the Postmaster-General, and brought to his notice the want of any frequent steam communication between North and South Uist, Barra, Skye, Tiree, Coll, and Oban. The Postmaster-General promised to take into immediate consideration a letter on the subject embodying the representations of the deputation, which also asks for improved telegraphic facilities.

Arrangements are being made for the extension of the telegraph, under guarantee, from Brodick to Corrie, in the Island of Arran.

A New Telegraph Company.—A new company has been formed in New York under the name of "The United States West India Cable Company," who propose to establish telegraphic communication by means of submarine cables between the city of New York, the coast of Florida, and the West Indies.

Death of an Aberdeen Telegraph Clerk Abroad.—The *Panama Star and Herald* of the 11th June, announces the death of Mr. William Summerfield in that city from yellow fever. The late Mr. Summerfield was a native of Aberdeen, Scotland, and was twenty-seven years old. He was the eldest son of Mr. Edward Summerfield, inspector of postal telegraphs, Aberdeen. He arrived in Panama on the 25th of May, *en route* to Lima, Peru, to take his position as an operator with the Central and South American Cable Company. Three days previous to the sailing of the vessel by which he was to proceed he sickened with the fever which has ended so fatally.

Telegraph Clerks and Sunday Work.—A contemporary writes:—"Among the anomalies which distinguish the treatment by Government of their servants, not the least remarkable is the marked distinction drawn between telegraph clerks in London and telegraph clerks in the provinces. Attention has lately been directed to this with special regard to payment for Sunday labour. In London the clerks who work on Sunday are paid for doing so; in the provinces they are not. For this difference neither Mr. Fawcett nor anybody else has been able to give any satisfactory reason. It appears to be entirely a matter of custom."

The Work of the Royal Engineers.—The first division, Telegraph Brigade, Royal Engineers, commanded by Captain Jelf, whose camp is now at Chobham Common, have, in the course of their drill, just completed a telegraph line between Windsor and Portsmouth, a distance of 60 miles. The left half of the division, under Captain Bennet, marched from Chobham to Aldershot, whence the corps, in four detach-

ments, each of eight men, and four waggons containing reels, wire, and poles, ran a wire, *viâ* Woolmer, to Portsmouth, the 36 miles being accomplished in a couple of days, at the rate of 18 miles a day, and 22 poles being allowed for each mile. Telegraphic communication already existing between Aldershot and Chobham Common, the wire was carried from the latter place on poles, by way of Sunningdale, Blacknest Gate, Queen Anne's Ride, and the Long Walk, to the private grounds of Windsor Castle, and at the rear of the houses on the east side of Park Street to Windsor Post-office. This and the Portsmouth office were made the terminal stations of the line, the intermediate offices being at Chobham, Aldershot, and Woolmer. The most successful effort during the drill was the construction of 3 miles and 100 yards on Queen Anne's Ride in 59 minutes. A portion of the telegraph brigade is under orders for active service in, it is believed, the Soudan. On Sunday night a telephone was attached at the Windsor end, and answered admirably.

Damaging Telegraph Wires.—This offence appears to be on the increase, or, at any rate, offenders have recently been more frequently detected. A lad was fined 10s. at Glasgow last week for throwing stones at telegraph insulators, and at Tarbert, Loch Fyne, several boys were admonished for a similar offence. Last week, at Bradford, four youths were ordered to be flogged for throwing stones at and damaging telegraph wires belonging to the Lancashire and Yorkshire Railway Company.

Telegraph Revenue.—The telegraph service yielded £440,000 from the 1st April to the 12th July last, against £515,000 in the corresponding period last year.

The Franchise Bill.—The electric railway at the Forestry Exhibition, Edinburgh, was not completed as expected on Saturday last, owing to the workmen having gone to take part in the demonstration on the Franchise Bill!

The Institution of Civil Engineers.—The Miller scholarship has been awarded to Alfred Richard Sennett, Stud. Inst. C.E., for his paper "On the Electric Light."

To Cable Manufacturers.—We understand that the committee of the Plymouth Chamber of Commerce has been considering, in all its bearings, the scheme for a submarine cable between the Eddystone lighthouse and the mainland. The probable length required would not exceed 10 to 12 knots, and we believe that tenders are invited for carrying out the work. Further information may be obtained by applying to the secretary at Plymouth.

Royal Agricultural Society.—Messrs. Ruston, Proctor and Co., of Lincoln, are exhibiting at the Shrewsbury meeting of the Royal Agricultural Society of England, a high pressure compound-engine, which they state embodies several valuable improvements, and has, in a long series of experiments, proved singularly economical in fuel. On account of its regularity of speed, it is claimed to be particularly adapted for driving electric light machines.

Holiday Trip. — Last Saturday the employés of Messrs. W. T. Glover & Co., electrical wire and cable makers, Manchester, had an enjoyable outing at the expense of the firm, Blackpool being visited by a large party, including the wives of the workmen. Through the munificence of, and the excellent arrangements made by Mr. Glover, breakfast and dinner were supplied free of charge, and tickets of admission to places of amusement were freely distributed; the day's wages were also paid as usual. Mr. James and Mr. Hall undertook the charge of the party, and so well were the comfort and pleasure of all concerned maintained during the day that Mr. Glover hopes to repeat the trip next year.

Electric Bells and Fire Alarms.—We observe that Messrs. Eck, Callow and Co., manufacturing electricians, have secured the contract to fit the workhouse school of St. Mary, Islington, and the infirmary, Hornsey Road, with electric bells, and also the workhouse of the same parish in St. John's Road, Holloway, with electric fire alarms.

Electrical Transmission of Power.—At the Cork Agricultural Show last week, Mr. Gerald Percival, who had charge of the electric lighting arrangements, gave a manifestation of the transmission of power by electricity, driving two churns and a worker by means of the current from a Gramme machine, conveyed through the whole length of the electric light cables, a distance of about 1,800 feet, to a Jarman dynamo, which acted as a motor. The same agency was afterwards employed to work a chaff-cutter.

Universal Electric Company, Limited.—The liquidators of this company report to the Court as follows:—This company was incorporated in 1881 with a capital of £20,000, divided into 4,000 shares of £5 each, all of which were issued. In 1882 it was resolved to increase the capital to £250,000, but none of that increase was issued. An order for winding up under the supervision of the Court was made in March, 1883, and Thomas Wilson, accountant, Glasgow, and Alex. Murray, C.A., were appointed joint liquidators. On entering upon their duties the liquidators found that at the date of the resolution to wind up the whole of the capital had been called up, but the calls were unpaid on a large number of shares. On proceeding to settle the list of contributories, and endeavouring to enforce payment of these unpaid calls, the liquidators found that no formal allotment of shares had been made by the directors, and that in some cases not only had no allotment taken place, but the usual payment required on applications for the shares had not been made. A Mr. Sorley explains that he arranged with the secretary of the company that the application was to be treated as qualified by the stipulation that the electric light was to be fitted up in his premises within a fortnight from the date of the application, which was never done. The liquidators are advised that they could not succeed in establishing liability against Messrs. Glen, Sorley, and White, and they therefore craved to have their names deleted from the register of shareholders. The existing members having been unable to satisfy the debts of the company, the liquidators proceeded to settle on the list of contributories those past members who ceased to be members within a year prior to the commencement of the winding up. The liquidators craved authority from the Court sanctioning their past and proposed actings, and their lordships granted the authority sought so far as regarded the removal of the three names.

The Railway Accident at Sevenoaks.—Reporting upon this catastrophe, Major Marindin, R.E., Board of Trade Inspector, states that the system of electric block signalling adopted by the South Eastern Railway Company is capable of great improvement.

Protection from Lightning.—"An Edinburgh Citizen" writes to a contemporary suggesting the erection of lightning conductors upon the highest points in large towns, stating that it has been found by actual experience that a proper conductor, placed on the top of a building, will protect a radius equal to about twice the height of the rod.

Personal.—Mr. A. Gray, assistant to Sir William Thomson in the Natural Philosophy department of Glasgow University, has been appointed Professor of Physics in the North Wales University College.

In order to commence business for himself, Mr. H. C. Harold has, we are informed, resigned his appointment with Messrs. Johnson and Phillips, the eminent firm of telegraph engineers, with whom, for some years, he has held a responsible position.

Electric Railway Patents in America.—The interference between Stephen D. Field and Thomas A. Edison, of New York, and E. W. Siemens, of Germany, involving the question of priority of invention of the fundamental principle of the electric railway system, which has been pending in the United States Patent Office for four years, was decided on June 25th in favour of Field. This is a very important decision, as it gives to the successful contestant the virtual control of this invention within the United States.

Obituary.—M. l'Abbé Moigno, who has held an important position in the scientific and industrial progress of the century, has just died at an advanced age. Towards the end of his life he had been specially engaged with electricity, and even contributed to the creation of the Société Universelle d'électricité Tommasi. An eminent man of science, M. l'Abbé Moigno devoted his leisure moments to the editing of the journal *Les Mondes*.

The Breaking of Overhead Wires.—Mr. F. W. Neale, of the Glebe Street Telegraph Works, Stoke-on-Trent, writes to us as follows :—"The statement in your issue referring to a telephone wire breaking in Hanley and lifting a child up into the air, &c., was got up by a local penny-a-liner to cause a sensation during the agitation that is now going on as regards underground and overhead wires. The true facts of the case are as follows :—On Monday afternoon, 30th ult., a waggon, carrying a large cricket hut, was being drawn along the top of Cannon Street, in Hanley, followed by a number of children because of its unusual height, This hut caught a telephone wire, which pulled a bracket made of iron 1 inch by ½ inch at right angles to its former position ; half the chimney then gave way, and the bricks, in falling, broke the wire. A horse took fright at the noise caused by the falling chimney, and kicked a little child up in the air about three feet, at the same time knocking the child out of its way. Fortunately the horse's hoof went underneath the child's body, and the only injury it suffered was, its right foot was slightly inflamed. As regards the North Staffordshire Infirmary wire, the statement is entirely incorrect. The wire has not been broken since it was fixed three years ago.

Palace Chambers, Westminster, Co. v. London and Globe Telephone and Maintenance Co., Limited.—An Order was recently made by Mr. Justice Pearson for the removal of a telephone wire from land and walls belonging to the plaintiff Company. The Telephone Company appealed, and in giving judgment on Thursday, Lord Justice Baggallay characterised the action of the defendant company in affixing their wires to a party-wall as a very high-handed proceeding. Admittedly they had no right to do what they had done, but they said that the plaintiff company were not the proper persons to complain. They said that the land was not the land of the plaintiff company and that the latter had no interest in the party-wall against which the wires were placed. Upon the materials before the Court, it would appear that the plaintiffs were interested in the party-wall. It was necessary to consider the circumstances under which these wires were placed against the wall. Before the present question arose, the defendant company had carried a telephone wire through a trench across a piece of land said to be owned by the plaintiff company, and four or five feet from the wall ; this was complained of, and the right to complain was recognised by the defendant company, who undertook to remove the wire and fill in the trench. This was done, but the wire, when removed from the trench, was placed against the party wall, so that the one interference recognised as improper was followed by another interference of a similar character immediately afterwards. Under these circumstances, he was of opinion that the granting of the injunction was right, and that the appeal against the order made by Mr. Justice Pearson should be dismissed with costs. Lords Justices Cotton and Lindley concurred, the latter remarking that he regarded the appeal as nothing more nor less than an impudent and unscrupulous attempt on the part of a wrong-doer to take advantage of the reluctance of the Court to grant an injunction.

Our Gutta Percha Supply.—We learn from the *Journal Telegraphique de Berne*, that it is the intention of the Dutch Government to commission the director of the botanical garden at Buitenzorg (the residence of the Governor-General of Java) to go into the question as to what districts in the Preanger Regencies would be most suitable for the cultivation of the gutta percha tree. This step in advance is mainly owing to the great interest that has been taken in the study and cultivation of those trees by Mr. G. W. ten Brummeler, Inspector-General of Posts and Telegraphs in Dutch India. It may be noted that in the Colonial Exhibition, which was held last year in Amsterdam, the Government of Dutch India exhibited a magnificent collection, consisting of several hundreds of samples of gutta percha and India rubber, obtained from the jungles of the large Sunda Islands. Referring to a previous notice on a similar subject in our number of 12th April last, we are glad to see that active interest is being taken in this very important question, and the likelihood of a favourable issue is all the greater when we find that the question is being dealt with by those who might naturally be expected to derive the greatest benefit from ultimate success, as the greater part of the gutta-producing area is practically in the hands of Holland. It is now, we think, the duty of the English Government to take some definite action in the matter, for as things stand now, the reproach of irrational conservatism, which has often been so liberally bestowed on the Governments of Dutch India, comes with but an ill grace from a country which, like our own, has to complete the education of the students of the Woods and Forests Department by sending them to France, to the "Ecole Forestière" at Nancy. That "they manage these things better in France" we find evidence in the fact, that although the manufacture of gutta percha goods in that country is small in comparison with its use in England, we have to wait patiently until we learn, as the result of the inquiry of a French commission, that the climate and soil most suitable for the plantation of gutta trees is in Pahang, a small independent state, close to Singapore, which is amenable to the influence of the English Government. Without admitting the thoroughness of the French inquiry, we cannot but own that both France and Holland are distinctly taking the lead in this matter, and we regret that our own country should remain almost stationary, and without excuse, for the argument generally used in such cases will not apply, as on account of the time which must elapse before the timber comes to maturity, the planting of gutta trees is not a matter that can be carried out by private enterprise.

Water Gravitation and Electricity.—A discussion has recently taken place in a Glasgow paper as to the utilisation of water-power for the purpose of lighting the town by electricity. A suggestion to this effect was made by Mr. Adam Drysdale, eliciting the remark from Messrs. Muir and Mavor that the scheme was open to the serious objection that for lighting purposes the mains for transmitting the current over the eight miles from the reservoirs would be so costly as to put the arrangement quite "out of the sphere of practical politics." It was quite possible, they admitted, that power for a few lights in the immediate neighbourhood of the reservoirs might be economically obtained from the water flowing into them.

Joint Stock Companies.—Notice is given that at the expiration of three months the names of the following companies will, unless cause to the contrary is shown, be struck off the register, and the companies will be dissolved :—Anglo-Spanish Telegraph Company, Limited ; Britannia India Rubber and Kamptulicon Company, Limited ; Direct American Telegraph Com-

pany, Limited; Direct Atlantic Telegraph Company, Limited; Economic Telegram Company, Limited; Electric and General Engineering Company, Limited; Globe Telegraph Company, Limited; Atlantic Telegraph Company, Limited; and North Atlantic Cable Company, Limited.

Opposing a Bill.—The Metropolitan Brush Electric Lighting Company is opposing the South Eastern Railway (Various Powers) Bill, under which the railway company seeks exemption in respect to part of its undertaking from the provisions of the Lands Clauses Act, which require that where any railway company desires to acquire a portion of certain property it shall, if called upon, take the whole. The property of the Electric Lighting Company is required, and as the passing of the bill would affect it prejudicially, the company protests.

Underground Wires.—An officer of the United States Electric Company, recently, speaking of the law just passed to compel all wires to be put underground by November 1, 1885, said:—"The result would be similar to that in Chicago when the city authorities cut down the wires, the companies having failed to comply with a city ordinance requiring this to be done. The consequence was there were no wheat or stock quotations, and the merchants forced the City Council to repeal the order. People here are just as dependent, and more so, on electricity, and would not tolerate an interference with its operation. We have not had time to think how this law, if enforced, will affect the various electric light companies. We should be concerned only indirectly; but I am confident the law will be a dead letter until it is repealed."

The New York *Electrical Review* says that the telephone and electric light people have not yet recovered from their amazement caused by the wholly unexpected action of Governor Cleveland in signing the bill. "Why," said J. P. Davis, the vice-president and general manager of the Metropolitan Telephone and Telegraph Company, "why, if we should have the streets in lower New York given up to us exclusively, we could not perform the physical labour between now and November 1st of next year."

At the International Forestry Exhibition, Edinburgh, Messrs. Stewart and Berry's system of conduits for underground electrical conductors is to be practically tested. One of the principal objects of the experiment is to show whether wires laid in granolithic conduits require gutta percha coatings.

Mutual Courtesies.—The thirty-third meeting of the American Association for the advancement of Science will be held at Philadelphia from September 4th to the 10th. The British Association has invited the members of the American Association to join in the meeting at Montreal, and the American Association has invited the members of the British Association to take part in the Philadelphia meeting.

NEW COMPANIES REGISTERED.

Cordner, Allen and Company, Limited.—Capital, £30,000 in £5 shares. Objects: To take over the business of electrical and general engineers carried on by Messrs. Cordner, Allen & Co., at 20, Bucklersbury, and at Wandsworth Bridge Wharf, Fulham. Signatories, with 1 share each: *W. J. Cordner and P. R. Allen, of 20, Bucklersbury; *T. M. Collett, electrical engineer, 4, Great Winchester Street; J. Clegg, J. Cranke, *J. S. Sawrey and Myles Kennedy, of Ulverston, Lancaster; and *J. Ashworth, of Dalton-in-Furness. Directors' remuneration: £1,000 per annum. Messrs. W. J. Cordner, T. M. Collett, and J S. Sawrey are appointed managers, and in addition to a share in the directors' remuneration, will be entitled to 50 per cent. of the balance of the net profits remaining after payment of 6 per cent. per annum. Registered 11th inst., by Messrs. Blair and W. B. Girling, of 3, Guildhall Chambers.

Crossley Telephone Company, Limited.—Capital, £100,000 in £5 shares. Registered office, Albany Buildings, Market Street, Bradford. Objects: To purchase the telephonic and electrical business carried on by Messrs. Louis John Crossley, John F. Harrison, and Walter Emmott, trading as the Crossley Telephone Company. Signatories, with 1 share each: *L. J. Crossley, Halifax; *J. F. Harrison, Rawdon Hall, by Leeds; *J. A. Steinthal, Bradford; *A. W. Lasson, Bradford; W. J. Crossley, Openshaw, Manchester; J. Campbell, Bradford; W. Emmott, Halifax, electrician. Directors' remuneration: £1,000 per annum. Registered 11th inst., by Mr. S. S. Seal, of 15, Serjeant's Inn, Fleet Street, as agent for Messrs. Rawson, George, and Wade, Bradford.

Saxby and Farmer, Limited.—Capital, £200,000 in £10 shares. Objects: To purchase the business of mechanical and electrical engineers and manufacturers of railway signals, locking apparatus, and safety appliances carried on by Messrs. Saxby and Farmer at Kilburn, and also at Creil, France, and at Brussels. Signatories, with 1 share each: *J. Saxby, Wivelsfield, Sussex; *J. S. Farmer, Hampstead Heath; *C. Hodgson, Cricklewood; J. Saxby, Upper Tooting; W. Buck, Kilburn; T. Perry, 23, Kilburn Park Road, Maida Vale; J. Saxby, Kilburn. Directing qualification, 50 shares, or £500 stock. The purchase consideration is £100,000, of which £50,000 is payable in fully paid shares. The stores and material will be purchased at cost price, and stock in trade, &c., at a valuation. Registered office, Patent Railway Signal Works, Canterbury Road, Kilburn. Registered 15th inst. by Messrs. Faithfull and Owen, 6, Westminster Chambers, S.W.

* Signatories whose names are preceded by an asterisk are also directors.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

China and Japan Telephone Company, Limited.—The annual return of this company, made up to the 3rd inst., was filed on the 9th inst. The nominal capital is £20,000 in £1 shares. 14,761 shares have been taken up and are fully paid; 3,712 shares have been subscribed for since the statutory return was filed. Registered office, 3, Great Winchester Street.

Removal of Office.—The registered office of the British Insulite Company, Limited, has been removed from 20, Coleman Street, E.C., to Charlton, Kent.

CITY NOTES, REPORTS, MEETINGS, &c.

United Telephone Company, Limited.

THE fourth annual ordinary general meeting of this company was held at the offices, Oxford Court, Cannon Street, E.C., on Tuesday, Mr. James Brand, chairman of the company, presiding.

Mr. Thomas Blaikie, the secretary, having read the notice convening the meeting,

The Chairman rose to move the adoption of the report and accounts, and the declaration of a dividend. He stated that £53,604 had been expended during the year; of this sum, £26,378 was on the London business, £14,000 on the business in the provinces, and £13,326 on instruments distributed all over the country, and on royalties. The money spent in the provinces was upon stations that were now being worked by the company, such as Bristol, Southampton, Brighton, Ipswich, Norwich, and various places in South Wales, but subsidiary companies were in course of formation, and when completed would repay the whole of the outlay. Meantime the stations were doing very well, and had become very valuable adjuncts to the business. The revenue account for the year showed an increase of £27,500, and a favourable feature in connection with this fact was, that the working expenses had only increased by £5,500. They would see that the directors were now grappling in earnest with the important matter of depreciation, although they were still, he was sorry to say, without any real and reliable data on which to form their calculations. Notwithstanding this, they had thought it right to write off £15,000 this

year. They proposed to pay a further dividend of 5s. 6d. per share, and he hoped this would prove satisfactory. Some might think that they might have paid a little more, but the business was still in its infancy, and they never knew what surprises might be in store for them; consequently they had thought it better to add £10,000 to the reserve account, and carry forward £5,000, making the reserve against depreciation over £65,000. As to the progress of the business, they would have liked it to have been more rapid, but on the whole they must not complain, looking at the generally depressed state of commercial affairs; to this latter fact, he thought, they must attribute the withdrawal of some of their subscribers, whilst the same circumstance, no doubt, kept many from joining the exchanges. Another company was doing its best to keep people from joining them by offering them for £10 what this company gave for £20. Since the last information which had been issued with respect to their relations with the General Post Office, he had been in communication with the Postmaster-General, who had pledged himself to personally take all matters concerning them in hand, and he (the Chairman) believed that he really wished to relieve their grievances, so far as was consistent with his duty to the public. In this matter he had to thank many Members of Parliament who had interested themselves in telephony on behalf of their clients and of the public. They had had a very busy and eventful year; but unfortunately in the latter half they had had a great deal of litigation. They had won two or three important actions against infringers; and the Wandsworth Board of Works, and the Bristol Corporation, took proceedings against them in regard to the question of overhead wires. They were bound to defend their position, and the result was, that in the Wandsworth case Mr. Justice Stephen, whilst deciding that their wires were not a source of danger or nuisance to the public, decided against them on the technical ground that they were trespassers on the property of the Board of Works. The Court of Appeal, however, decided in their favour, and now the local authority must show that actual danger existed before their wires could be meddled with. Upon this decision, negotiations were entered into which they hoped would lead to a friendly and reasonable settlement in other cases of a similar character. The telephone companies, carrying on their business in their own interests and those of the public, were anxious to meet every requirement of the authorities, and to avoid arousing the susceptibilities of the public, and they had done a great deal to minimise all possible sources of danger by running wires in cables containing each not less than 20 wires; it was almost impossible that these wires could fall. A great deal of money had been expended in this manner, and that accounted for the large outlay on capital account. As yet there was very little advantage evident from the use of these cables; but that would appear in future balance sheets. They had used every effort to pass through Parliament a bill to provide for the proper regulation of overhead wires by some central authority, such as the Board of Trade. While the Government was not indisposed to go into the whole matter, they would not allow them to press the bill whilst litigation was pending as to the authority of the local boards in the matter. They would gladly put the wires underground, but that was simply impossible, notwithstanding the letter which recently appeared in the *Pall Mall Gazette*. With regard to the trunk wires connecting exchanges in different towns, not much progress had been made. The position taken by the Post Office made it impracticable, and it was useless to struggle against it. The company preferred to do almost nothing, and await the result of their present negotiations. If the issue were satisfactory, it must result in an enormous development of telephonic business, and he did not think it would do any injury to the telegraph revenue of the Post Office. The Chairman then remarked upon their entry for the first time upon their new premises, and, after expressing the grateful thanks of his brother directors to Mr. Morgan, the managing director, whose devotion and self sacrifice had been great and untiring in the interests of the company, concluded by moving "That the report and accounts be received and adopted, and that a dividend for the half year ending 30th April, 1884, of 5s. 6d., free of income tax, on the fully paid £5 shares (part-paid shares receiving in proportion), be now declared."

Mr. J. S. Forbes (deputy-chairman) seconded the resolution, and said there seemed in some minds to be some doubts as to whether the implement in which they were interested was one of great social and commercial value. They could hardly imagine, if their views were correct, that a great public department, such as the Post Office, could be so blind to the fact that the public would, sooner or later, insist on having the use of means so valuable for intercommunication. But a great deal of misunderstanding still existed upon the subject, and he was surprised to find men of the highest commercial standing who did not recognise that in the telephone they had the means of adding to their own comfort and to the efficiency with which they might conduct their affairs. He was afraid this country was slower than some others; and progress did not seem to be so rapid as they anticipated it would have been. But yet it had been very substantial. In April, 1881, they had 914 subscribers on the exchange lines, and an average of 943,000 calls. In 1884, the subscribers had increased to 3,350, and the calls to 6,120,000. The private lines in 1881 were only 186, but had now increased to 715; and that notwithstanding all the difficulties put in the way by a department which, he would respectfully submit, ought to know better. He was surprised to find recently an emanation in the *Pall Mall Gazette* from a well-known electrical engineer, who was also a philosopher, Mr. Sylvanus Thompson, upon the dangers of overhead wires. Mr. Morgan, their managing-director, knew more than any other man in this country about this business; he knew all the difficulties that occurred in practice, but he was without any record of the dangers alluded to. Mr. Thompson acknowledged that there had as yet been no experience in that direction, but told them to wait four or five years, when they would have such a crop of accidents as would drive their wires underground. The American Bell Telephone Company, in their last report, said:—"It is common to see in the public papers round statements that the wires are to be at once ordered underground. In this matter, we have the strongest motives for wishing to get the wires underground as far and as soon as it can be done, without destroying the efficiency of the service. The plant would be more permanent, and no longer liable to interference or to destruction from storms, whilst maintenance would be cheaper and easier. In the present state, however, it is impossible to put the bulk of the lines underground without interfering seriously with the facilities on which the public are beginning to depend." These remarks applied with equal correctness to London. If they were to have a great public convenience it would be sure to be attended by some slight drawback. What they had to do was to look before they leapt, and not to be alarmed by crotchetty people.

The resolution having been unanimously agreed to,

Mr. Cohen inquired whether the directors had decided when the remaining call was to be made. The uncertainty was a great loss to many shareholders who might be compelled to realise part of their shares, as it unduly depressed the price of the shares in the market.

The Chairman replied that he could not say when the remaining call would be made. A transaction was now in hand which, if carried through, might necessitate a call; but it was by no means certain, and they had no immediate need of money.

Mr. Holman inquired as to the value of the shares in subsidiary companies held by the company, and

The Chairman answered that the Lancashire and Cheshire Company's shares were saleable at 27s., but there was no quotation for the others. If the telephonic business succeeded as well as he expected and had every reason to believe, the National Company, the Northern Company, and the Telephone Company of Ireland, would one day, and at no very distant date, repay the amount at which they were issued.

Several questions were put relative to the proposed agreement with the London and Globe Telephone Company, but these the chairman declined to answer, as the negotiations were not yet concluded.

Messrs. James Brand and James Staats Forbes, the retiring directors, and the auditors, Messrs. Quilter, Ball & Co., and Messrs. Price, Waterhouse & Co., were re-elected, and the meeting terminated with a vote of thanks to the chairman.

Indian and Oriental Electrical Storage and Works Company, Limited.—Notice is given of the registration of the Order made on the 14th ult. by Vice-Chancellor Bacon, confirming the reduction of the capital of this company from £400,000 to £280,000. The minute showing the particulars required by the statute is as follows:—"The capital of the Indian and Oriental Electrical Storage and Works Company, Limited, is £280,000, divided into 10,000 deferred shares of £3 10s. each and 70,000 ordinary shares of £3 10s. each; at the time of the registration of this minute, none of the deferred shares have been issued; the sum of £2 5s. has been called up upon each of 30,000 of the said ordinary shares, and the sum of £3 10s. is to be deemed to be paid up upon each of the other 5,000 ordinary shares; and none of the remaining 35,000 ordinary shares have been issued."

Faure Electric Accumulator Company, Limited.—Creditors of this company are requested to send their names, addresses and particulars of their debts to Francis Cooper, Herbert Canning and Richard Alexander Brown, the liquidators, at the office of Messrs. Cooper Bros. & Co., chartered accountants, 14, George Street, Mansion House, on or before the 14th August.

Telegraph Construction and Maintenance Company, Limited.—Notice is given that the transfer books of this company will be closed from the 14th to the 22nd inst., preparatory to the payment of an *ad interim* dividend of 12s. per share.

India Rubber, Gutta Percha and Telegraph Works Company, Limited.—The directors will, at the meeting of this company to be held on the 22nd inst., recommend the distribution of an interim dividend of 5 per cent. or 10s. per share, free of income tax.

Kelway's Electric Log Syndicate, Limited.—The creditors of this syndicate are required to send their names, addresses, &c., to the liquidator, Edwin J. Morris, 58, Lombard Street, E.C., on or before the 12th August.

Electric Carbon Storage Company of Scotland, Limited.—A second dividend of 5s. (making 10s. in the pound) is now due and will be paid on application to the official liquidator.

TRAFFIC RECEIPTS.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending July 11th, 1884, were £2,539, after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited.

PROCEEDINGS OF SOCIETIES.

Physical Society, June 28th.

Prof. GUTHRIE, President, in the Chair.

New member—Mr. W. H. Hensley.

Lord RAYLEIGH made a communication "On the Practical Use of the Silver Voltameter for the Measurement of an Electric Current." At a former meeting of the society the method was explained by the author, but on the present occasion the apparatus was exhibited. The author considers this the best method of determining the strength of current in absolute measure. One ampère deposits 4 grammes of silver in an hour, therefore ¼ to ½ an hour is sufficient to give 1 or 2 grammes, quantities which can be measured with accuracy. Any current from $\frac{1}{10}$ to 4 or 5 ampères can be measured successfully in this way. With very weak currents there is a difficulty in weighing the deposits; with very dense currents the deposit is apt to be irregular. The author deprecates the use of acetate of silver; pure nitrate or pure chlorate of silver giving the best results. The cathode of his apparatus is a platinum bowl; the anode a silver sheet wrapped with clean filter paper sealed over it to keep any loose silver from dropping on the cathode. The anode is immersed in the solution of silver salt, and at the end of several hours (if great accuracy is required) a measurement of the weight of silver deposited is made by weighing the bowl cathode in a chemical balance.

Dr. FLEMING enquired whether it was not better to weigh the loss of weight suffered by the anode, as is sometimes done.

Lord RAYLEIGH had not found this plan so good, the anode being apt to disintegrate and lose weight otherwise than by electrolytic action.

Prof. GUTHRIE remarked that with small electrodes peroxide of silver is formed, and that the inferiority of acetate of silver might be due to formation of subacetate.

Lord RAYLEIGH then made a communication on a "Colour-mixing Apparatus founded on Refraction." This apparatus had been described at a former meeting of the British Association, and consists of a double refracting prism, a lens, dispersing prism and screen, by which an overlapping of spectra can be obtained, and thus a mixture of colours. In comparing different eyesights with it, Lord Rayleigh finds that the majority of persons are more sensitive to red than he himself. In answer to Mr. W. Baily, he had not observed any difference between the two eyes of the same person, except what might be due to fatigue and freshness.

Dr. GUTHRIE inquired if the author had discovered any racial characteristics of colour blindness.

Lord RAYLEIGH had not observed any, so far.

Dr. GUTHRIE stated that though colour-blind to red, he believed he was more than usually sensitive to blue.

Dr. STONE and Mr. STANLEY referred to known cases of blindness to green as well as red.

Dr. LODGE asked if persons abnormally sensitive to red could see further down the spectrum.

Lord RAYLEIGH believed they could see the spectrum brighter nearer its limits, at all events.

Mr. GLAZEBROOK briefly described a modification of Lord Rayleigh's apparatus, by which the distance on the spectrum which anyone can see could be measured.

Mr. C. V. BOYS read a paper on "A Phenomenon of Electromagnetic Induction." Between the poles of an electro-magnet a small disc of copper is hung by a bifilar suspension. If the magnetic field is uniform, and the disc at an angle to the lines of force, then on making the magnet it is jerked parallel with the lines of force. If it is a changing field, and the disc perpendicular to the lines of force, it is repelled on making the magnet, and attracted on breaking by the nearest pole. This phenomenon, which was observed by Faraday, was shown by Mr. Boys to be useful for determining the intensity of a magnetic field by measuring the throw of the disc, on magnetising and demagnetising. It might also be employed to measure the resistance of bodies in the form of plates, from their diameter, moment of inertia, and observed throw. Any structural difference of resistance in different directions in the body might be determined by its means. Mr. Boys illustrated his remarks with curves of results obtained by experiment.

Lord RAYLEIGH considered that the effect of self-induction in the results was not likely to be serious.

Mr. J. HOPPS read a paper "On the Alteration of Electrical Resistance in Metal Wires, produced by Coiling and Uncoiling." An experiment was made with an inclined plane, the angle of which could be varied, and a car, carrying bobbins, which was drawn up or let down the plane by the wires experimented on. It appeared that coiling and uncoiling tends to produce hardness in a wire. Coiling produces an increase of resistance, and uncoiling a decrease in the resistance of a wire.

Mr. R. T. GLAZEBROOK, M.A., F.R.S., read a paper on "The Determination in Absolute Measure of the Electrical Capacity of a Condenser, and on the Method of Finding, by Electrical Observations, the Period of a Tuning Fork." The paper described experiments conducted according to a method given in Maxwell, Vol. II., § 776, for measuring the capacity of a condenser. Mr. J. J. Thomson showed (Phil. Trans., 1883, Part III.) that Maxwell's formula is only approximate, and gave the correct formula which was used in the author's experiments. In these, tuning forks were used of frequencies approximately, 16, 32, 64, and 128 to a second, the frequencies being determined by a careful comparison with the clock by Lord Rayleigh's method, and the corresponding values found for the capacity were ·3336 mf., ·3340 mf., ·3335 mf., ·3337 mf. The mean is ·3337 mf., and the experiments do not show any variation in the capacity, as the time of charging varies from $\frac{1}{16}$ to $\frac{1}{2^5}$ of a second. The condenser was furnished by Messrs. Latimer Clark, Muirhead & Co. The method also gives a ready and accurate means of determining the pitch of a tuning fork; for if the capacity of the condenser used is known, the frequency (n) can be determined. The author has used the method successfully for this purpose.

Lord RAYLEIGH objected to mercury contacts in such experiments; and Dr. STONE said he had found iron and mercury contacts good.

Professor HERBERT MACLEOD exhibited a sunshine recorder, made by placing a water lens in front of a camera box and lens. Sensitised paper is placed in the bottom of the box, so that the focussed ray strikes on it, and as the sun moves, traces a curved line or band on the paper. Several of these records were shown to the meeting. The society adjourned till November 28th.

NEW PATENTS—1884.

9674. "Telephone receivers." J. H. JOHNSON. (Communicated by P. G. Scrivanow.) Dated July 2.

9724. "Inducing electric sparks for gas lighting and like purposes." A. R. MOLISON. Dated July 3.

9727. "Treatment of disease by polarity or magnetisation." R. EUSTACE. Dated July 3.

9735. "Secondary batteries." W. TAYLOR, F. KING. Dated July 3.

9753. "Machine of electrical power to aid or to take the place of steam with success and economy of 60 per cent." J. B. DENIS. Dated July 4.

9825. "Alphabetical electric telegraphic instruments." R. C. WILLIAMS. Dated July 7.

9870. "Manufacture of galvanised wire." L. HILL. Dated July 7.

9801. "Measuring and recording electrical energy." F. Walker. Dated July 5.

9911. "Locking and unlocking railway signals and signal levers and signalling trains by electricity." E. J. HOUGHTON. Dated July 8.

9927. "Reproduction at a distance of characters, signs, delineations and motions." T. LUBINI, G. C. COOKE. Dated July 8.

9929. "Electrometer." A. WRIGHT. Dated July 9.

9934. "Electric arc lamps." W. KINGSLAND. Dated July 9.

9935. "Holders for glow lamps." J. SWINBURNE. Dated July 9.

9843. "Frames for electrodes in secondary batteries." F. G. HOWARD. Dated July 7.

9855. "Telephone switches and circuits." P. JENSEN. (Communicated by Stockholms Bell Teléphon Aktiebolag.) Dated July 7.

9957. "Automatic electric lighting apparatus." C. S. SNELL. Dated July 9.

9961. "Diaphragms for telephonic puoposes." G. GRAY. Dated July 9.

9978. "Electrical self-registering money tills, applicable for other purposes." B. W. WEBB. Dated July 9.

9982. "Transforming and distributing electric currents and apparatus therefor." C. D. ABEL. (Communicated by C. Zipernowsky M. Déri.) Dated July 9. (*Complete.*)

9896. "Electric mangers for the prevention and cure of crib biting." B. S. WESTON, H. S. WILTON. Dated July 8.

9969. "Anti-magnetic shields for watches." C. K. GILES. Dated July 9. (*Complete.*)

10002. "Electric batteries." J. H. JOHNSON. (Communicated by P. G. Skrivanow.) Dated July 10.

10021. "Conductors for telephonic and telegraphic purposes." G. H. SMITH. Dated July 10.

10054. "Composition of materials to be employed in protecting and insulating wires, &c." A. PARKS. Dated July 11.

10060. "Frictional gearing applicable to electric motors for reducing and changing speed." W. B. BRAIN. Dated July 11.

10061. "Primary and secondary batteries." W. B. BRAIN. Dated July 11.

10075. "Method or means for effecting registration of marine compasses at a distance therefrom." J. LEA, G. C. HARVEY. Dated July 11.

10079. "Coating of metals with an electro deposit of platinum." W. A. THOMS, A. J. LARGE. Dated July 12.

10088. "Apparatus for the reproduction at a distance of characters, signs, delineations, and motions." T. LUBINI. Dated July 11.

10129. "Lighting railway and other vehicles by electricity applicable for other purposes." B. P. STOCKMAN. Dated July 14.

10154. "Producing and utilising induced electrical currents for telegraphy and other purposes." W. P. THOMPSON. (Communicated by P. H. Vander Weyde.) Dated July 15.

CORRESPONDENCE.

Primary Batteries.

In two Lalande-Chaperon cells which I have recently set up, I find the copper oxide is dissolved by the caustic potash solution, the latter becoming of a deep blue and continuously attacking the zinc when the battery is not connected. If you can inform me through the medium of your valuable columns how this is to be prevented, you will confer a favour upon

J. K. R.

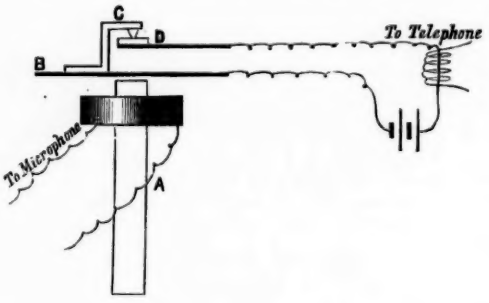
Rotherhithe, *July 10th*, 1884.

[Perhaps the representatives of this battery are in a position to assist our correspondent.—EDS. ELEC. REV.]

Telephonic Relay.

As no telephonic apparatus has been produced yet to transmit any great distance, I venture to suggest a relay, of which the following is a description :—

A is a telephone connected to distant microphone ; B is its diaphragm to which C is soldered, C having a carbon point attached to it ; D is a spring having a flat



piece of carbon fixed to it, and is so that the two carbons press lightly together ; a circuit is made, including the microphone, battery and primary of an induction coil, the secondary of which is connected up with the distant telephone.

It is hardly necessary to state that the vibrations produced by speech at the sending microphone are reproduced by the diaphragm, B, which sets the microphone relay in action and transmits it to the next telephone.

F. D.

July 11th, 1884.

[Similar arrangements have been proposed years ago, but no practical results have yet been attained.—EDS. ELEC. REV.]

The Speaking Telephone of 1854.

In the REVIEW of 1st March last, your correspondent A. Danvers will find in a letter from me all the information he requires in regard to the *description* of a telephone by Charles Bourseul. I use the word *description*, because it has not yet been discovered that Bourseul ever made an instrument as described by him. The description of Bourseul's telephone was published first in a journal published in Paris, 30th July, 1854, *L'Illustration*.

In the REVIEW of 28th June last there is an article headed "The History of the Telephone," signed "E. Berliner," wherein he gives a faulty translation by himself of Bourseul's telephone, published in the *Didaskalia*, in 1854, which, he says, "will be interesting to all electricians." Perhaps many electricians had read a correct translation of the Bourseul telephone in my letter in the REVIEW of March 1st, last. To paraphrase Mr. Berliner's language, "can we assume that Berliner, belonging to the cultured class of a city of over 100,000 inhabitants, and a correspondent of the REVIEW, did not read the letter in the REVIEW of March 1st last ?" "Can we assume that Berliner did not read the wonderful ideas presented therein by Bourseul," and having "come across an old semi-weekly newspaper," prepared a verbal (*sic*) translation of it and sent it for publication to the *Electrical World* to enlighten all electricians.

Mr. Berliner seems to be particularly unfortunate in his line of argument to prove that Reis was not the inventor of the telephone, but "was practically only Bourseul's assistant and merely carried out the mechanical parts of the problem." Mr. Berliner gives emphatic contradiction to that statement in the following words :—"how can it be explained that instead of employing the powerful alternate attraction and release of a diaphragm by an electro-magnet for a receiver, so plainly hinted at in 1854, he, in 1860, resorted to the feeble vibrations of a needle core ?"

That Reis did not employ the means described by Bourseul would seem to show that Reis either did not know of that description, or that he preferred his own line of research and would not adopt the ideas of another and put them forth to the world as his own. Mr. Berliner's paper sustains this view of Reis's action, and proves the contrary of what he wishes to establish. It is not out of place here to ask, how does Bell stand in regard to the Bourseul description of a telephone ? I submit that Bourseul's description describes what Bell claims as his invention better than Bell has done in his specifications for his patents, and I assert that Bell had read that description before his pretended invention. I cite the testimony of Bell himself to prove my assertion.

In many previous communications to the REVIEW I have cited Bell himself, to prove that he was thoroughly acquainted with all of Reis's telephonic inventions, and therefore that he was not the inventor of the telephone, but only an improver of Reis's telephone. Bell's lecture delivered before the Society of Telegraph Engineers, in October, 1877, furnishes the evidence that he had read and studied many German writers who had described Reis's telephone of 1861-62, and also that he, Bell, had read Du Moncel, wherein is given Bourseul's description of his telephone.

The question, Who is the inventor of the speaking telephone ? has been subject matter of discussion *ad nauseam ;* but I now submit to every intelligent person, can it be said honestly that Bell was the inventor of the telephone for which he obtained a patent, when the fact is established by Bell's own admissions that he had read the description of Bourseul's telephone before he had made his own telephone ?

W. C. Barney.

July 14th, 1884.

Continuous Current Induction Apparatus.

M. F. de Wolffers's last letter indicates too much sophistry to merit but few comments—the second paragraph, to wit.

I can only re-assert in another form what I stated in my last letter, viz., that M. F. de Wolffers has made an error in theory. The induced current is *not* caused by the sliding of the poles through the bobbins, as in the Gramme dynamo machine, when its armature is rotated mechanically, but it is the effect of the rotation or reversal of magnetic molecules caused by the periodical reversal of primary current in the bobbins. The action of M. F. de Wolffers's apparatus and my own involve precisely the same phenomena—electro-dynamic. M. F. de Wolffers's machine would give a minimum, and my own a maximum effect ; the difference between the two being purely a matter of degree.

M. F. de Wolffers asks why I took no notice of "the latest form" of his apparatus. It was because I could see nothing in it except what is known as a separately-excited Gramme dynamo, and that in its very worst form. This machine cannot properly be classed as an induction apparatus, as the term is generally understood, and as a dynamo it involves such serious mechanical difficulties, that no one would think of constructing such a machine. Moreover, this "latest"

machine bears evidence of having been designed under the inspiration, but mis-interpretation, of Mr. Rankin Kennedy's suggestion in your issue of June 21st, and is sufficiently transparent to show, on the part of its author, an ingenious attempt to get out of a difficulty. As I had no wish to be unnecessarily severe in my last letter, I abstained from commenting on M. F. de Wolffers's "latest" effort.

Will M. F. de Wolffers be good enough to substantiate his assertion that my apparatus is not new? M. F. de Wolffers may do this by referring to any published work, English or foreign, so as to give me an opportunity of refuting his statement.

As to M. F. de Wolffers's conclusions on my communication some time back, I suppose he means my letter published in the REVIEW the 24th of last May. I think, however, that I am justified in ignoring any theory, even the conservation of energy theory, when I prove that it is no longer true. Others may do the same in one form by carrying out the installation as explained in the above-mentioned letter (May 24th). I know this is scientific heresy; but, if I may misquote, there is more in Heaven and earth than is dreamed of in all our conceited philosophy.

E. L. Voice.

July 12th, 1884.

[We think that enough has now been said on this matter.—EDS. ELEC. REV.]

A New Form of Differential Galvanometer.

With reference to the description of a new form of differential galvanometer by Dr. August Voller, published in your issue of to-day, may I direct your attention to a paper on "A New Method of Determining Large Electric Currents and Very Low Resistances," read by me before the Society of Telegraph Engineers on May 25th, 1882, where the same form of galvanometer was described and its applicability to measuring the resistance of the different parts of an electric light circuit demonstrated.

P. Cardew.

Chatham, 12*th July*, 1884.

Heinrichs v. Westinghouse.

I have noted your fair notice on the above action in your last issue, but since the abrupt stoppage of my case by the learned Judge, and as the judgment given may leave a false impression on the minds of your readers and my business friends, I beg of you enough space to state shortly the questions at issue in this action, the evidence brought forward by me and my witnesses, and the judgment given by Mr. Justice North.

The main questions at issue were, as rightly stated in your last issue, viz.:—That I had in an agreement with the defendant in this action agreed (*a*) to complete and pay for the machines *already made* for the purpose of illustrating and demonstrating the practicability of the invention; (*b*) to proceed before the 30th September, 1881, to Pittsburgh, U.S., and to associate myself there with the persons designated by the defendant; (*c*) to apply for and use my best endeavours to obtain United States' patents and to assign the same to the defendant immediately upon their being obtained; and (*d*) to apply myself exclusively to perfecting the apparatus, &c., &c., for five years; the defendant was to pay for all material and appliances, &c., and he had agreed to work the United States' patents and pay me £2,000 per annum royalties.

I had pleaded that as soon as the said agreement was executed, I performed all that was required to be performed, and I was ready and willing and waiting to go to Pittsburgh whenever the defendant should send me there. That after the signing of the agreement I was induced to go for a few days to Paris to order a few circular carbons of my old carbon maker Mr. Carrè, but that the defendant had wished me to meet him in Paris, at the office of his friend Mr. Goodwin, who was a carbon maker; that the defendant ordered carbons during my absence, and then induced me to fetch my machine and lamps from London to Paris to show it to Mr. Goodwin, so that he might be better able to make carbons; that I was, later on, induced to stay in Paris and construct a new and larger lamp, which Mr. Goodwin undertook to make; that I was, later on, induced to stay in Paris and do all such work as I had agreed to do in Pittsburgh, since the defendant stated that his new works at Pittsburgh were not then finished.

After the defendant had succeeded in keeping me for nine months in Paris under different pleas, the work stood as follows in Paris: no carbons were ever made at Goodwin's, a few new lamps had been badly made, three new machines had been commenced, but much of the work had to be done over and over again.

I remonstrated with the defendant as to the waste of time and money; he then stated that the whole charges should be made a lien on my French patents, but since the defendant has under the agreement no right on my British, French and German patents, except an option to acquire one-half share on payment of a substantial sum of money to be paid before the 1st January, 1884 (which has never been paid to me), I declined to give any lien on my French patents, and as the defendant maintained his statement for several days I refused to stay any longer in Paris except under the condition that the defendant would give me in writing what he had long ago agreed to do, namely, to pay for all the machines made in Paris, and then to fix a time for me to depart to Pittsburgh; the defendant refused to accept my terms and he then refused all payments, after which I took Counsels' opinion, which led to this action.

The defendant had pleaded as follows:—He denied that I had done all I had agreed to do; he denied that I had made a machine and lamp so as to be able to exhibit my system and invention in full operation. He stated that I had never perfected sufficiently any machine or lamp for such purpose. He denied that I had been ready and willing and waiting to go to Pittsburgh. He admitted my allegations as to the ordering of carbons in Paris and the taking the machine for that purpose to Paris. He admitted that I had made lamp drawings of a new lamp, but he pleaded that before the new lamps could have been made, I had withdrawn the drawing. *He admitted that his works in Pittsburgh were not finished at that time;* but he pleaded that in September, 1881, I had agreed to make a new machine and lamp in Paris, to show the practicability of my invention in Paris; he stated he had never agreed to pay for the machine nor to fix any time for me to stay in Paris.

He admitted that Goodwin had undertaken to make the machines, and that he was a capable manufacturer of dynamos. The defendant admitted in his pleadings that I had complained to him in May, 1882, that the machines were incomplete, and as to the waste of time and money, but he pleaded that since the great delay was my own fault, he had hesitated to pay the expenses, and demanded that such expenses should be a lien on my French patents. He admitted in his pleading that since the 13th May, 1882, he had stopped all payments.

I have argued before the judge that since the French patent rights were my own, I could stop at any time the defendant working in Paris, particularly as I hold the sole right to work there; and the fact that I stayed in Paris instead of in Pittsburg was only a personal forbearance on my part with the terms of the original agreement.

I have further shown to the judge, when I acquiesced to work in Paris, it was only to please the defendant and to suit his convenience, as his works in Pittsburgh were not finished; but since during the nine months stay in Paris his friend, Mr. Goodwin, had done so little work, and when I complained to the defendant he had asked me to have the expenses settled upon my French patents, I thought myself, under the circumstances, fully entitled to ask the defendant to agree to pay all expenses, and to fix a time for me to leave for Pittsburgh; thereupon the defendant stopped all payments on the 13th May, 1882, and I thereupon declared, by my legal adviser's letter of the 28th June, 1882, the agreement at an end.

The following evidence was given on my behalf. Mr. H. R. Kempe, and Mr. P. F. Nursey, the Editor of *Iron*, stated about as follows:—That they saw, in or about March, 1881, the machine, and one of the three lamps which were in Court, in action; the lamps flickered a little, but that was due to the roughly and hand made carbons, and irregularities of the engine, that the system was well in operation, and demonstrated perfectly the practicability of the invention.

Mr. A. Derrin, the maker of the machine, stated that on the day the defendant inspected the system it was as well in operation as on other occasions; that the defendant's solicitor paid for the machines on my behalf; that a new commutator was in his hands at the time when the defendant inspected the system, and that this new commutator was delivered to the plaintiff later on, and was now fixed on the machine produced. The old commutator was produced to Mr. Derrin and sworn to being the old one.

My own evidence was as follows:—

That the new commutator was the only thing to be completed when the agreement was signed, and at that time nothing was said as to my stay in Europe. I was to leave at or before the specified time for Pittsburgh; in fact, when I went to Paris it was only on a pleasure trip to see the Electrical Exhibition, and afterwards I wanted to go for a week to Germany. I bore out my statement as to the ordering of the carbons, then the several requests by the defendant as to my stay in Paris, then the making the lamp drawings; and I produced one of the very lamps made according to the drawing in Paris, and which had been in operation in December, 1881; that the wire on the armature of my small machine had become burnt in September, 1881, in Paris, by being over-driven by the badly governed engine at Goodwin's, but had been rewound. I produced the drawing of the new machine and the three armatures, and three sets of different lamp drawings. I constructed in Paris, also, drawings of carbon presses, all of which were made and to be used for the Pittsburgh undertaking. I proved that the defendant had, in November, 1881, decided to discontinue to employ Mr. Goodwin, and persuaded me to go to Glasgow to some other business friend of his firm, but when I asked for terms he had again refused to work Glasgow, and in-

duced me to stay in Paris and wait for carbons, and make up the larger machines. I proved that in November, 1881, a completed set of working drawings of the first large machine had been delivered to the said Goodwin, who had undertaken to make the machines in his own works, and who has these very drawings still in his power or possession. I further proved that I had, in fact, been induced to construct all such drawings of machines, lamps, fixtures, &c., and other appliances, as would be required for the working of the United States patents in America. I proved that the defendant had, on the 5th and 6th of May, 1882, refused to pay the expenses incurred, and wished the same to be charged on my French patents. I proved that the defendant had refused at the same time to fix a date within which the said Goodwin would complete the three machines and lamps. I was willing to remain in Paris provided the defendant would fix a time for my departure for Pittsburgh and pay all expenses; if not, I was willing to perform within the original agreement.

The defendant's learned counsel attempted to shake my evidence in cross-examination; he asked me whether my small machine (weighing 500 lbs.) was not a toy machine, and whether the new machine made in Paris was not the completion of the old machine. I then stated that the small machine had proved to give the largest results for its size, namely, eight arc lights of 2,000 candle power, and that a new commutator was the only thing I had agreed to complete. I stated that I had never agreed to stay in Paris, but I had acquiesced to stay for a few months in Paris to please the defendant, whose works were not ready at that time in Pittsburgh. The learned counsel asked me when the defendant had refused to make any payments. I said he had admitted in his pleadings, in the 23rd paragraph of his defence, that he stopped on the 13th May, 1882, all payments; the defence was handed to me and I read the paragraph.

The learned counsel has not been able to shake my evidence, and I stated in re-examination that the old machine had, after being rewound, been in use and burnt 5 large lamps with circular carbons. The carbons were made at the works of my old carbon manufacturer, Mr. Carré.

Mr. T. E. Gatehouse stated that he was an expert in a position to state in distinct terms as to the practicability of the machine and lamps; that he had conducted during 5 weeks in March and April last exhaustive tests of this machine*, which have proved that this machine is a most excellent and complete one, that this machine had burnt 8 lamps perfectly well, and that the circular carbon lamp had behaved very well indeed; that in this lamp irregularities from defective regulations were avoided, since this lamp contained no regulating mechanism, and had a constant length of arc; that the burning of the wire of the armature in Paris was sufficiently explained by me, and that such accidents are common to all machines. Drawings of the new machines, as made in Paris, were produced to Mr. Gatehouse, who after inspection declared the new machines to be of the same construction as the old machine, except in regard to the manner in which the brushes were held; further, that the drawings were complete, and of such nature that any maker of dynamos would be able to make machines without further supervision.

This concluded the evidence on my behalf. There were a great many more side issues, *i.e.*, in regard to the taking out of the American Patents. The defendant had insisted that his friend, Mr. Christy, of Pittsburgh, should apply for the patents; but this gentleman, being retained by the Brush company, had refused to act for me; but on the defendant insisting that Mr. Christy should do the work, the latter undertook the work under the condition that he was to report to the defendant only, and not to me at all.

I had also proved that no carbons had ever been made by the said Goodwin, but a few roughly-made carbons had been ordered by the said Goodwin at Mr. Carré's, my former carbon maker's.

This closed the case on my behalf, and since counsel for the defendant had asked previously during the proceedings for leave to examine a witness, I deferred summing-up my case until the defendant had stated his case according to the practice. But immediately after the counsel for the defence opened his case, I heard with great surprise the learned judge state that I had not made out my case, and he declined to hear the defendant's counsel except on the questions of money due to me, which I had been induced to advance.

On Thursday, the 10th July, the learned judge gave judgment in the following condensed terms. The judge considered that the machine made was never completed; all evidence given showed the state of the machine prior to the date of the agreement; that when the machine had an accident in September, 1881, in Paris, shortly thereafter the new large machine was commenced; that plaintiff had agreed in December, 1881, to have the new machines made, and plaintiff had acquiesced to staying in Paris until the machines had been made; that as to the waiting for the carbons the plaintiff had acquiesced; though the plaintiff might have remained in Paris upon the representation that Goodwin would open new carbon works, still his failure to do so was no breach of the representation; that if the defendant had neglected to supply the plaintiff with proper accommodation, that would not justify the plaintiff in rescinding the original agreement.

That the terms the plaintiff put to the defendant on the 6th May, asking him to fix a time for plaintiff's departure to Pittsburgh, was a ridiculous term to attempt to impose, since the learned judge considered that the bargain was that the plaintiff was to stay in Paris until one new machine was completed.

That when the plaintiff, in his letter of the 6th May, 1882, refused to stay further in Paris, it amounted, in fact, to a repudiation of the agreement, and led the defendant to refuse the plaintiff's salary, and the plaintiff was not entitled to rescind the agreement with his letter of the 28th June, 1882.

And the learned judge dismissed the action with costs, allowing the plaintiff's accounts of May and June, 1882, which were partly cash advanced by him.

With all due submission to the above judgment I still maintain that I have proved my case and was entitled to judgment, or at least a refutation of my evidence from the defendant.

As stated before, my case is as follows: that the old machine and lamps were complete, and the uncontradicted evidence has proved the practicability of the system, the only thing to be completed being the commutator, which has been completed. The defendant has not disproved this, nor shown that the commutator was not the completion of the machine; further, the learned judge has omitted from his judgment the evidence of Mr. Gatehouse, who proved the completion of the machine by the results of the tests taken by him last March.

My case is that I did not agree to make one machine and lamp in Paris, but I stayed in Paris as if I had been in Pittsburgh constructing machines, lamps, carbons and other things to be used in Pittsburgh, thus actually working the American business in Paris. I had acquiesced to do so since the defendant's works were not finished in Pittsburgh. The work as arranged by the defendant in Paris made not sufficient progress and the defendant wanted the expenses to be a charge upon my French patents. I declined then to stay in Paris. The learned judge has omitted to consider the defendant's admission in the 20th paragraph of the defence, that he hesitated to pay the expenses and wanted them to be a charge upon my French patents.

The learned judge has omitted to consider the defendant's admission in the 23rd paragraph of the defence that he had, since the 13th May, 1882, discontinued making any payments to the plaintiff, *i.e.*, refused to make all payments to be made under the agreement.

I have proved that I had not agreed to make only one machine and lamp in Paris, but I have carried on the whole working of the American patents in Paris. I had proved this on oath with the production of all the drawings executed in Paris, and of all of which copies had been delivered to the said Goodwin.

I have argued before the learned judge that since the French patents right was my own property I could stop and prevent the defendant at any time working the American patents in France.

I have argued before the learned judge that when the defendant had disputed on the 5th and 6th May, 1882, his liability to pay the expense as admitted in the defence, and then refused to make terms with me, and refused to let me proceed to Pittsburgh and work the patents there, and then refused on the 13th May, 1882 (as admitted in the defence), to make any payments whatever, it amounted to a total refusal to perform the agreement. I then waited six weeks, applying constantly through my solicitors for terms, or the Pittsburgh address, and money, and not until the 28th June, I declared the agreement rescinded after the defendant's total refusal to conform with any of the terms thereof.

I quoted to his Lordship the well-known authority Ehrensperger *v.* Anderson, 3 Welsby Exchequer Reports, in which it has been laid down that the absolute refusal of one party gives rise to a right to rescind in the other party.

I further fully argued before his Lordship that if he considered I had done anything which amounted to an agreement to work in Paris instead of in Pittsburgh, such an agreement would be void for want of consideration, particularly since it amounted to a working upon my own property. I quoted to his Lordship the authority: Robson *v.* Collins, 7 Vessey's Reports in Chancery, where it was held that where a second contract is alleged, but without consideration, the original contract remains intact and may be executed without regard to the second. An extension of the terms according to a variation of the agreement, also in writing, was refused on the ground of want of consideration.

I had further argued that I sustained damages through the defendant's refusal to work the American patents properly, and had proved by Mr. Gatehouse that the old machine was as perfectly made as other machines, and that a considerable number could have been made and sold of that size; but his Lordship seems not to have considered this point at all, and he has partly passed over much of my evidence, given on oath, to the effect that I had made no agreement to work only one machine and lamp in Paris; on the other hand, his Lordship had accepted many suggestions of the Statement of Defence without calling upon the defendant to substantiate his defence or to disprove and dispose of the evidence given by me and my witnesses.

I have to bow to the judgment, though I trust your readers and my business friends will judge for themselves as to the merits of my case when perusing the above statement, adding the fact that the United States' patents have not been obtained through defendant's refusal to supply the monies as he had agreed to do, and that the judgment gave no direction to the defendant that he was to work the United States' patents, though no damages were given to him for the alleged breaches of the agreement on my part, as no opportunity had been given to the defendant to prove his case, and it can rightly be questioned by me whether the defendant was in this country and in a position to do so.

Charles F. Heinrichs.

London, *July 14th*, 1884.

* See ELECTRICAL REVIEW, April 26th, 1884.